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V. R. GARDNER, Director - - - - - - - J. G. DUNCAN, Editor

THE QUARTERLY BULLETIN

The Quarterly Bulletin of the Michigan Agricultural Experiment Station is issued in February, May, August and November. It presents: (1) progress reports on long-term major research projects; (2) final reports on short-term projects and (3) short, timely articles of a popular nature that bring together information from various sources on subjects in which farmers are interested.

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A CASE STUDY IN TOWNSHIP ZONING*

By SOLON T. KIMBALL
SECTION OF SOCIOLOGY AND ANTHROPOLOGY

VOTERS OF Grant Township,* Adams County, Michigan, at a special election held in August 1945, rejected by a sizable margin a proposal to zone the township. One hundred sixty expressed disapproval and 118 favored the proposition. The majority of the non-voters were generally believed to have been opposed. The substantial majority of negative opinion appeared in spite of the fact that only one man actively campaigned against zoning, while there were many among those in favor who worked to secure acceptance.

The proponents of zoning were those who lived in a residential neighborhood on a main highway named Woodlawn Drive adjacent to the town of Concord. They were suburbanites who had sought some of the advantages of rural living and, in the process, had developed a satisfactory community life among themselves. The threat of industrial development in their neighborhood had roused them to seek some solution that would permit them to retain the kind of community in which they lived. The solution which they hoped would meet their needs was zoning. They had turned to the Township Board for assistance, but this group had denied their petition, which then caused them to seek an expression of the entire community through a township-wide referendum on zoning. Their high hopes that other township residents, most of whom were farmers, also saw their problems and would lend approval, were dashed when the results of the voting became known. Frustrated in their attempts, they blamed the township supervisor for their defeat since he had been the one who had actively campaigned against zoning. They were almost completely unaware of a number of serious mistakes they had made, mistakes which alienated the support which they believe the issue warranted.

When one seeks rational explanations for the rejection, the decision appears puzzling. Problems affecting the type of land use in the south-

*The events which are described in this article are actual happenings. The geographic place names are fictional. It seems probable that there are a dozen or more localities in Michigan where the same conditions exist and where the same series of events might have transpired. The author is indebted to Mr. C. V. Ballard, of the Extension Service, and Dr. Louis A. Wolfanger, of the Conservation Institute, for his introduction to the problem and the area. He is additionally indebted to Dr. Wolfanger for reading the manuscript and offering valuable editorial suggestions.

ARTICLE 28-31

ern third of the township are quite similar to those which occur in the rural areas adjacent to cities experiencing population growth and industrial development. The northern boundaries of the city of Concord, a town of 9,000 persons, projects into the township, and includes approximately two square miles. Concord is a local trade center supplying the wants of a surrounding agricultural community, possessing a progressive small college, and having several busy manufacturing plants. Like all cities where production was expanded during the war, its housing problem is acute, caused partly by the lack of new building, but mostly by the influx of workers, some of whom were from southern states.

Even before the war there was a movement of population northward from Concord into Grant Township partly caused by industrial expansion. Two factories have been built in the extreme northeast corner of the city, and the erection of a third is scheduled to begin in the near future. A foundry and several other commercial establishments are now located on the main highway east of the city (in Grant Township). Others have bought land preparatory to building. During the war, population spilled into the township on the west of Concord with the construction of a government trailer camp.

With industry moving north, population is almost certain to follow. The presence of a stable, prosperous farming group, occupying large fertile farms on the south of the city makes movement in that direction less likely. It appears probable that the next ten years will see the construction of many new dwellings, and the possible location of small industries outside the city limits in Grant Township. Unplanned and unregulated as this development would be without zoning, it would create serious problems of public health and safety, the need for public facilities, property depreciation, and a possible rural slum condition. All of these considerations might have influenced the decision reached during the balloting on zoning, but apparently were not understood by the majority. The residents in that portion of the township immediately affected by industrial expansion favored zoning as a measure to regulate growth, but they did not constitute the majority, who were influenced by other factors in their voting. We can see what some of these factors were by a consideration of the present pattern of occupation and land use.

Most of the residents of Grant Township are members of farm families. The 1,200 persons resident in 1940 represent a 25-percent increase since 1920. With only a handful of exceptions the farms are single-family operated. Agriculture is diversified with emphasis upon small dairy herds. Many of the farmhouses are neatly painted with good farm buildings, but there are some dwellings and buildings which

have not seen a coat of paint in years and, also need repair. Land quality is uneven, and size of farm and soil fertility are undoubtedly related to economic instability. The precarious economic position of a sizable segment of the farm populations was demonstrated by the fact that during the depression years one-third of the farm population was on the relief rolls at one time or another. During the war years many of the younger men and some farmers took employment in factories in the towns and commuted to their jobs. A pattern has been started, which, with full employment, may well continue in the future.

No one would deny that these farmers should have a real interest in the future of their township, the use to which land is put, and the kind of people who might become their neighbors. One of the more prosperous farmers did see a future problem and spoke with some concern of the possible future sub-division of a nearby farm into five-acre tracts to be sold to city workers for building sites.

Although the farming community is facing serious problems in the near future, the impetus for zoning came from the newer residents, the suburbanites. The farmers were considered to have been almost solidly massed against the zoning proposal.

The proponents of zoning were found in one small section of the township. These were the "Woodlawn Drive People". Woodlawn Drive is a stretch of highway of approximately one mile in length extending from the eastern limits of the city of Concord to the county line. It is a section of the main arterial highway, connecting Concord with larger cities, both east and west.

The approximately 40 families resident along the "drive" represent many occupations. They are in the professions of law, medicine, and teaching. Some are businessmen, salesmen, or employees in local factories. There are a few who make all or part of their living from the land which they occupy and have greenhouses or poultry establishments. There are several who have retired. One man has built a foundry, which was opposed and resented by the other residents. Only three of these families are farmers, and they along with the other farmers of the township were reported to have opposed zoning.

The Woodlawn Drive people are proud of their homes and neighborhood. There is a Woodlawn Drive Woman's Club. There is also a Woodlawn Drive Improvement Association which tries to promote the best interests of the residents. Several of the women belong to clubs in the city of Concord, and one of them is president of the Parent-Teachers Association: All of them send their children to the Concord schools. Through profession and business, through associations and cultural interests they are related to the town of Concord. They are

people who have bought or built property along Woodlawn Drive and live there is preference to living in the city.

The Woodlawn Drive people think of themselves as being neighborly. Some of them have banded together to buy milk cooperatively. Others share the unused portions of their acreages as common grazing ground for beef animals which, when slaughtered, are divided among the sharers. Some keep a cow or two for their own use. They have large gardens, fruit trees, and berry patches. Most of them have mutual interests which are different from those of the farmer residents of the township. They are city people who have sought some of the advantages of rural living, but who have never identified with the interest of the farmers. Geographically, they live in the extreme southeast corner of the township. They are a people apart and have been willing to remain that way. As one of them remarked, "I am sorry to say it, but we have been a pretty self-satisfied community. We get along with each other. We have our own interests and clubs, and we haven't paid much attention to the rest of the township."

If the Woodlawn Drive people are a self-centered group oriented toward urban life, the farmers also have their interests, which are centered on the land and among other farmers. There is little in common with the suburbanites. The map shows seven rural elementary schools. Each of these draws children from the surrounding neighborhoods and is under the supervision of a school board. There are two women's clubs, one of which includes membership from an adjacent township. There is a home demonstration women's group. The Farm Bureau counts some of the farmers as members. Only a handful have any direct associational or occupational interest in Concord.

The political interests of the township is served by a township board. Its members include three farmers, the wife of a shop foreman, who is resident on Woodlawn Drive and who is secretary, and the township supervisor who lives a couple of miles outside of Concord and has a few acres which he devotes to garden, but is not a farmer. There is a town hall, and a township-owned fire truck. It was this board which by a four to one vote rejected the petition presented by the Woodlawn Drive people to zone the township, and which led to the referendum where zoning was rejected.

Before we consider in more detail the reasons for the action taken by the board and the voters, it would be well to understand the impetus which led to the presentation of the original petition.

The threat of new industrial construction along the Woodlawn Drive forced home upon the residents that something had to be done and done quickly if they were to preserve the kind of community in which they lived. Rumors circulated that a foundry which had recently burned was

to be rebuilt and enlarged; that property had been bought by a farm machinery company to erect a sales and repair building; that a lot for building machinery had been planned; that another lot was to be used for a garage or road house or some other undesirable activity. The Woodlawn Drive people did not relish the thought of these industrial activites. They wanted their street to remain a residential neighborhood. They turned to zoning as the process which would solve their difficulties. After discussion and agreement a petition was circulated to request the township board to adopt a zoning ordinance.

This was not the first time that the tranquillity of Woodlawn Drive had been disturbed by industrial intrusion. Five or six years previously word was circulated that a newcomer to the road intended to build a foundry on part of the land which he had acquired. A meeting of residents was called at which the Woodlawn Drive Improvement Association was formed and officers elected. The threat was discussed. Those attending the meeting sought legal means by which they could prevent the new construction, but they were advised by the township supervisor, who attended the meeting, that zoning was of doubtful constitutionality* and that the most desirable way to settle problems was through mutual agreement. A member of the Improvement Association was delegated to call upon the new owner to request that he build elsewhere. According to his story, he met not a willingness to discuss the problem, but a torrent of abuse. He was asked why they (the new family) had not been invited to the meeting of the previous evening and "was it because the Woodlawn Drive people felt that they weren't good enough to associate with them." The emissary was bluntly told that the foundry would be built and they would live there whether the Woodlawn Drive people liked it or not. Interest in zoning became dormant and remained so until the new situation arose.

Following the rejection of the petition sponsored by the Woodlawn Drive Improvement Association and presented to the Township Board the first week in July, events moved rapidly, another petition requesting a special referendum to approve or reject the proposal to zone was circulated by the people of Woodlawn Drive. It was presented at the Board meeting of July 27 with 101 signatures. This was granted by the Board and the voting set for August 27. A public meeting to which the county agricultural agent and representatives of the state college were invited, was held in the Township Hall August 20. Those who attended were already favorably disposed, with the exception of the supervisor. The voters on the 27th, gave a decisive 160-118 rejection of zoning. The people of Woodlawn Drive were "stunned". They had believed that the election was "in the bag". They were particularly

*The U. S. Supreme Court has upheld the constitutionality of zoning.

resentful against the township supervisor whom they blamed for the defeat.

The feeling against the supervisor was expressed by one adherent as follows: "The township supervisor was against us. He suggested that a petition for a special election be held and if by majority vote the township wanted it, then the township board would prepare a zoning ordinance.* This gave the township supervisor a chance to get people to vote against it. To each one he told a different story. To the penurious he said it would raise taxes $10,000, and he knew this wasn't true. To those who had boys in the service he said we should wait until the boys came home so we could learn what they wanted. To a man of education he said it was unconstitutional and that he had consulted some of the best lawyers in the state, but he never named them. To a farmer he said, 'You won't be able to put up a sign without asking the Woodlawn Drive people for permission.' At the meeting to discuss the proposition he advised those who were against to stay away. At the voting those in favor went early while those against came late. He had a man there whom he told to get more people to come and vote when it seemed they needed more votes to defeat it. What we can't understand is why he has done this to us. It has been the 100 votes of the Woodlawn Drive that has kept him in office year after year. Many of these people (Woodlawn Drive) were his cronies and thought the world of the supervisor, and they followed him like sheep a bell wether, but now they have turned against him."

The placing of full responsibility for the defeat of the zoning proposal upon the township supervisor is much too simple an explanation. It is true that he was against zoning, and that his opposition was an important factor. But he was effective in securing support for his point of view, only to the extent that he was able to organize the sentiment and attitudes of the farmers sufficiently to get them to act as he wished. There are three questions which should be answered if we are to understand what actually happened. We need to know why the township supervisor actively campaigned against zoning, what his avowed reasons were for his opposition, and how did those who voted "no" explain their opposition. We shall answer the last two questions first.

Whether the statements attributed to the supervisor by the zoning adherents were actually expressed by him is not too important. Those actively supporting the proposal believed that he did make these statements. The explanation for opposition offered by the supervisor, however, is somewhat different. He said he believed zoning to be unconstitutional. He felt it was contrary to the spirit of the Declaration of Independence and was a restriction on freedom of initiative; and as

*Not exact procedure.

such was a deterrent to progress. Through freedom for an individual to develop ideas or a process and then to find a place where he could produce a product, many men have made important contributions.

He asked, "who are we to get ourselves up as judges of what a man can or can't do? Furthermore, it would be better to wait until the boys in the service come home and see what they think. There are many of them who might want to start a garage or a little repair business, or something like that, and if we had zoning and they were prevented from doing this, they would feel that while they were away an advantage had been taken of them."

He gave as an additional reason why he believed it was not a desirable time for voting that the farmers were busy with their work and it would be difficult for them to take time off. He expressed the feeling that there had been a failure to consult. The Woodlawn Drive people had been the only ones who wanted the board to vote to zone. It was not until 24 hours before the meeting in early July, when the petition was presented, that the members of the board, except for the secretary, learned that such a petition was to be presented. Then at the public meeting one woman wanted the board to vote to zone right then. He concluded, "The people have spoken through the vote and they don't like the Woodlawn Drive people trying to go against the expression of the people."

What about those who voted against zoning?

That the supervisor's campaign against zoning was successful is shown by the vote. Those opposed were probably motivated by a variety of reasons, but expressions obtained from a few of the farmers in the township brought forth one point on which all were agreed—they were not going to have the people of Woodlawn Drive running the township. Some of these statements, much condensed and paraphrased, tell better than any summation what the farmers thought and felt.

One man said, "Farmers are independent and don't want to ask anybody if they can build a chicken coop or a hog pen or where they can put it. Zoning would be all right for one section of the township but not for another and the whole township would have to be zoned. They say that when the Woodlawn Drive people were told that the soldiers were away and the farmers were busy this time of year, they said 'so much the better because then they won't have a chance to vote against it'. Farmers wouldn't care if a factory was built right next to their farm in fact they might welcome it, but the Woodlawn Drive people want things a little nicer, and you can understand why they wouldn't want factories near their homes."

A farm woman expressed herself that "Zoning was voted down be-

cause the people weren't going to let the Woodlawn Drive people run their affairs."

A substantial farmer expressed much the same view when he said, "The Woodlawn Drive people want to run the township. We showed them they can't do it. They haven't given up yet. They tried to put it over when the rest of the people were busy with their farming. If we had not been so busy we would have voted it down by another hundred votes. There is no place for it in this township. Perhaps in big cities there is a reason. If it had gone through a farmer would have had to get a permit for everything he wanted to do. There is no use in voting a nuisance on yourself."

Another farmer, somewhat more tolerant, stated, "I can see their (the Woodlawn Drive) point of view. I didn't understand what it was all about. I heard it would cost $1,000 per year. Heard you couldn't build or repair without a permit and that you couldn't put up a sign to sell eggs or a produce stand. It wouldn't affect me here but it would others. One laborer told me that a man couldn't do his own plumbing if this went through. I suppose it all depends on the kind of men you get on the board. The next time it comes up I will study it out."

One prosperous farmer who lived close to Concord and who was in favor of zoning because, as he explained it, there was a likelihood that an adjacent farm would be sold in five-acre lots to low-income families from town, who would then "steal from your cornfield and your henhouse and pig lot," explained the defeat in much the same terms. He said the Woodlawn Drive people "tried to bull zoning through," that they "are suburbanites not farmers," and that the farmers "are slow thinking and in a thing of this kind you cannot hurry them. If you do they will be against you."

From these statements it becomes clear that as far as the farmers were concerned, the issue was one of farmer versus city people in which category the Woodlawn Drive people were placed. The farmer could understand and appreciate the problem of the people of Woodlawn Drive, but he was not going to be run by them and have to go down everytime he wanted to do something and ask their permission. They were not going to run the township and one way to make sure of that was to vote against zoning. It is apparent that the logical merits or demerits of zoning entered into the decision little, if any. The decision was made on a different basis, and then arguments adduced to substantiate the position taken. The mutuality of interests were ignored and the entire issue became one of emphasizing the differences. Although this explains the almost complete division of the voting into farmer versus suburbanite, it does not explain the position of the supervisor, who is not a farmer, nor a resident of Woodlawn Drive and who

must depend upon votes to retain his office. Why should he alienate one section of the electorate on this issue?

This question was also asked by the Woodlawn Drive people but in a slightly different way—they phrased it, "Why did he do this to us?" In a complex situation of this kind there were undoubtedly many reasons. Those offered by the supervisor himself may represent honest conclusions, or they may also be rationalizations to justify a position. One woman from Woodlawn Drive asked, "Do you suppose he was against it because we did not ask him first, and if we had let him introduce the plan he would have supported it?" Another suggested that he was a man who wanted to better himself and to associate with the kind of people who lived on the "drive," but that they had never seen fit to include him as one of them. The implication was that he resented his exclusion and this was a chance to vent his spleen.

Two events of past history may also throw some light on the situation. During the depression years there was some criticism by members of the Woodlawn Drive Women's Club of the method of distribution of relief which was a responsibility of the supervisor. At the next election an attorney, a resident of Woodlawn Drive announced as a competing candidate for the position of supervisor. The attorney was defeated. He was the one, however, who was a prime mover in the campaign for zoning. The contested election was interpreted by some as an attempt of the Woodlawn Drive people to displace the supervisor because of his reluctance to give, what was considered, adequate relief. His victory in the election was interpreted as the result of his ability to go along the "highways and byeways" and convince the farmers that his policies were to their interests.

Viewed against this background of divergent occupational and residential interests, community organization, and conflicting personalities, it becomes clear that the results of the election had practically no relation to the merits of zoning. The vote was an expression of the relative strength of two divergent groups resident in the same township. The discussion and expressions of opinion were manifestations of values and sentiments, and in their most abbreviated form became symbolized in the distinction of the "Woodlawn Drive" and the "people". It was an instance of a minority group wanting special privileges and special consideration, without attempting to explain adequately either why or how. It was a situation in which the supervisor was fighting for his political life, on an issue that he felt fairly certain he could command the following of the farmers, as he had in the past. Unwittingly, the actions of the Woodlawn Drive people threatened his position and leadership. Twice before he had met the threats successfully. The special election provided the opportunity for him to organize the

sentiments of the farmers and to get them to respond to his leadership. He knew how to utilize the electoral process from long experience, and he succeeded in getting the issue fought out on a level where he was fairly certain of success.

THE SIGNIFICANT SETS OF RELATIONSHIPS

The preceding narrative reveals five sets of relationships that were significant in the initiation and sequence of events that led to the rejection of the zoning proposal. For purposes of clarity, and to give added understanding of the narrative and later analysis these relationships will be summarized below.

1. The system of relationships among residents of Woodlawn Drive: The community of interests of the residents of Woodlawn Drive were expressed in their general neighborliness; cliques based on social status, occupation, etc.; and the women's club. The over-all agreement of the kind of neighborhood which they wished to maintain found expression in the Woodlawn Drive Improvement Association. This association had been organized several years previously to seek ways of preventing the then existing threat of industrial intrusion. It had remained inactive until the new threat of industrial development brought the residents together again. Its president was an attorney who had been a candidate for the office of supervisor about ten years previously, and was defeated by the present incumbent. This association sponsored the petition for zoning, the petition for a special election, made arrangements for the public meeting, and worked actively to secure approval.

2. The relationships of the Township Board: This board was composed of five popularly elected members. These included the supervisor, three farmer members, and the secretary who was the wife of a shop foreman resident on Woodlawn Drive. This is the group on which responsibility rests for conducting the financial and public affairs of the township.

3. Supervisor—Constituents: The relations between the supervisor and the residents are complex and varied. It is unnecessary to describe them in full detail, but it will be helpful to understand some aspects. The supervisor is in a position to assist individuals and groups, and to work for the welfare of the entire township through the County Board of Supervisors. He is considered a good supervisor if he keeps taxes low, spends money wisely, and otherwise protects the public interest. If the majority of the residents approve of his activities he is re-elected each term. Twice during his term of office residents of Woodlawn Drive had threatened his position. The first time was the criticism

of his handling of relief money and the second was the candidacy of the attorney for his job.

The residents of Grant Township divided themselves into two groups in terms of residence and occupation, the farmers and the suburbanites. The supervisor to retain his leadership was forced to meet the needs of both groups, but when there arose an issue in which the divergent interests of the two were revealed he found it politically expedient to side with the farmers. It was their support which some ten years previously had helped him defeat the Woodlawn Drive attorney.

4. Farmers — Suburbanites: The divergent interests of these two groups have already been described. The stereotyped attitudes which each group held of itself and of the other were indicative of the lack of strong mutual ties. Through the township board and particularly through the supervisor these differences were either resolved or made an issue of conflict. There were no other effective relationships either on a personal or organizational basis. The absence of common interests and traditional relationships was a serious handicap to the Woodlawn Drive residents in their attempt to secure support for zoning. The only effective method, after the original efforts, was through the supervisor and he prevented this.

5. Supervisor-Advisor: Within the township are a number of men who are called "leaders." These individuals play no active role in the formal affairs of the township, but they are looked up to as men with sound ideas and good advice. This group includes a lawyer-farmer, a politician-farmer, and insurance agent-farmer, and a farmer of independent wealth. There may be others. With these men as individuals the supervisor has developed a relationship in which he secures their advice and concurrence before he makes any major decisions affecting township affairs. The particular agreements, if any, which were reached with these men on the zoning issue are unknown, but it is known that not one of them was approached by any individual from the Woodlawn Drive at any time to secure support or understanding. One of these men was contacted through an intermediary but he took no active part. The failure to win the support of these "leaders" was disastrous.

The sets of relationships which integrate the residents of Grant Township include many more than those described above. The list would include women's and men's clubs, school boards, etc. Of these, the relationship of the leaders to others was the only one which could have played a decisive role and this one was never utilized.

MISSTEPS AND WHAT SHOULD HAVE BEEN DONE

The residents of Woodlawn Drive made several serious errors in their attempts to get approval for zoning. The narrative account and description of the significant relationships have been suggestive of some of these. The basic errors include the narrow definition of the problem, the failure to consult, the method of initiation, and inadequate explanation and communication.

1. The definition of the problem: The magnitude of the immediate threat to the Woodlawn Drive residential neighborhood was so great that problems of other parts of the township which might be met through zoning were neither seen nor understood. The original hope was to get zoning for Woodlawn Drive, not for the entire township. If the Woodlawn Drive could have been zoned and the remainder left untouched its residents would have been satisfied. Since the problem was seen entirely in terms of Woodlawn Drive, not only by the suburbanites but also by the farmers, the voters also cast their ballots on this basis. In order to make zoning acceptable to the farmer residents of the township, it would have been necessary to demonstrate that some of the problems faced by the farmers could have been solved through that device. Farmer attitude was "we have no problems which zoning can help and we are fearful that it will impose restrictions on us which we don't want, so we are against it".

2. Failure to consult: The failure to secure the advice and support of the "farmer-leaders" and to inform the supervisor and other members of the township board with the need and desired action earlier, was a second serious error. Following the agreement among Woodlawn Drive residents of the need for action, and the definition of the problem on a township-wide basis, appropriate representatives should have sought out the "farmer-leaders," as individuals, to secure their advice and support. This support would have had to be sought on the basis of benefit to both farmers and suburbanites, and if possible, arrange to have one of these men initiate discussions with the supervisor. The politician-farmer, who had originally encouraged the supervisor to seek that office, would have been the most logical for this move.

Following consultation with the "leaders," the next step should have been informal discussion with the supervisor of the problem and remedy. Since zoning represented an action of major consequence to the township and his political future, he would have undoubtedly consulted with his advisors before committing himself. If he found these men favorably disposed he would have been receptive to the idea and willing to initiate the action. It would then have been his responsibility

to convince the members of the township board to pass a zoning resolution. In this effort he would feel confident of support from both farmers and suburbanites.

3. Methods of initiation: The utilization of a petition as a device to secure action from the township board was a third error. Resort to this method should have come only if the supervisor and the board remained resistant to the informal approach. Furthermore, the petition should have been a joint undertaking with interested farmers so that it evidenced wide-spread support for zoning. The more desirable method of initiation has already been discussed in the preceding paragraph. Recourse to a petition calling for a special election was an equally serious error. It played into the hands of the supervisor and permitted him to organize sentiment against Woodlawn Drive and zoning.

4. Inadequate explanation and communication: All the errors previously listed are in one sense failures to communicate the problem and needs and to explain the methods of securing relief. They were such serious mistakes that it is doubtful if individual efforts could have overcome them. Efforts to bring knowledge and understanding to the farmer voters were made, but they were inadequate. These included a few newspaper stories, a single public meeting, and some personal campaigning. The president of the "Improvement Association" explained the defeat by the failure of those who wanted zoning "to go out and work for it." By that he meant door-to-door calls with explanations, and requests for support. That is the hard way.

Communication to be successful must be meaningful, it must provide incentives for people to take action, and it must be disseminated through existing social organization or systems of relationships. The proponents of zoning failed to make the need for zoning meaningful to the farmers and thus they failed to provide any incentives except opposition, and finally, they ignored the social organization among the farmers. In fact, questioning revealed an almost total ignorance on the part of Woodlawn Drive people that there were any farmers groups to which they might have taken their case.

WHAT NEXT?

The question which may have arisen in the minds of the reader was asked by the Woodlawn Drive residents among themselves, "What can be done now to get zoning?" This question is linked with another, "Could a favorable response have been secured under any conditions?" The answer is yes, but only if a sizable segment of the farmer residents become convinced of desirability of zoning and its direct benefit to

themselves. There are several ways in which this might be accomplished.

The situation as it now exists is one of latent conflict. The "zoners" blame the supervisor for the defeat. They may, and have already talked of, entering a rival candidate in the forthcoming election. Unless other issues intervene it is unlikely that any candidate supported by Woodlawn Drive could win. Even if he did win the problem of convincing the farmers of the need for zoning would remain, and if ignored would only create further conflict and hard feeling.

A second possibility is a change in the situation which would dramatically focus attention on the need to solve some problem. Such change might come from the construction of a new arterial highway through the farming section of the township. There is talk of such a possibility and if it eventuates the present supervisor could then shift his position "to meet the will of the people".

The third alternative is for the Woodlawn Drive leadership to take the steps they should have taken in the beginning. They must define the problems in terms of township-wide needs. They must then seek support from the farmer-leaders, and having won that support, they must either jointly with the farmers initiate a proposal for zoning, or let the initiation come from the farmers alone.

The utilization of this third alternative will now prove much more difficult than it would have in the beginning, for their previous failure will militate against their chances of securing the needed support. It must be done in terms of defining new needs so that the previous controversial issue of Woodlawn Drive versus farmers is dropped out of the context of zoning.

APPENDIX

A. The Sequence of Events

1. Woodlawn Drive residents discuss rumors of industrial construction in their residential neighborhood.

2. Meetings of Woodlawn Drive Improvement Association and decision to petition Township Board for zoning ordinance.

3. Presentation of petition to Township Board and its rejection.

4. Meeting of Woodlawn Drive Improvement Association to decide upon new course of action. Decision to request special township election by petition as suggested by supervisor.

5. Petition requesting special election presented to Township Board, accepted, and date set for election.

6. Supervisor campaigns against zoning. Woodlawn Drive residents work for.

7. Public meeting at which zoning discussed. Attendance almost entirely of proponents of zoning.

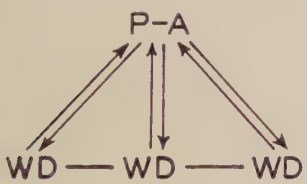
8. Election and rejection of proposition.

9. Attempts by one Woodlawn Drive resident to get two of Township Board members to reconsider, fails.

10. Opinion expressed by prominent resident "zoning is dead". Supervisor says, "The people have spoken against zoning". Woodlawn Drive asked question, "What did we do wrong and what can we do now?"

B. Diagrammatic Representation of Sets of Relationship

1. Woodlawn Drive Improvement Association:



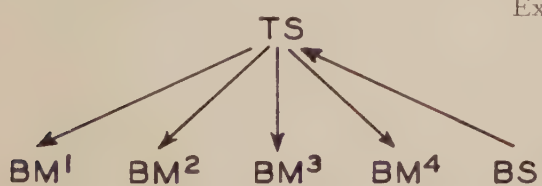
Explanation:
P-A = President-Attorney
WD = Woodlawn Drive Resident

(a) Descending arrow represents leadership taken by president-attorney in zoning fight. He was the one who advised on the strategy to be followed and made the important contacts.

(b) Ascending arrow represents delegation by residents of authority to take leadership in zoning.

(c) Horizontal arrows represent the interrelationships arising from the mutuality of interests in zoning.

2. Township Board:

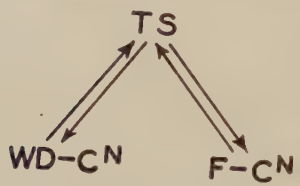


Explanation:
TS = Township Supervisor
BM = Board Member
BS = Board Secretary

(a) Descending arrows represent role of Township Supervisor as chairman. Normally, he calls meetings, introduces business, and secures agreement from members on course of action.

(b) Ascending arrow BS-TS represents part taken by BS in zoning proposal. She was one who asked that meeting be held at her house on Woodlawn Drive to permit petition requesting zoning be presented. She was also only one voting in favor of petition.

3. SUPERVISOR-CONSTITUENTS:

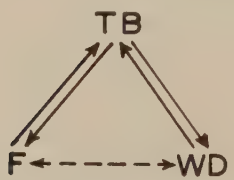


Explanation:
TS = Township Supervisor
WD-C = Woodlawn Drive Constituents
F-C = Farmer Constituents

(a) Descending arrows represent political favors, leadership in township affairs, supervision of local affairs, etc.

(b) Ascending arrows represent requests for aid, suggestions for handling township business and expressions of approval or disapproval through elections.

4. FARMERS-SUBURBANITES:

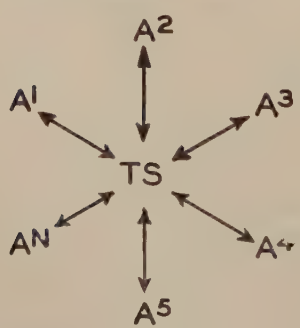


Explanation:
TB = Township Board
F = Farmers
WD = Woodlawn Drive Residents

(a) This relationship is actually a variation of the Supervisor-Constituent one. It shows however, that the only basis of mutual interest was common residence in a political unit and that the divergent political interests of the two groups ought to be resolved through action of the Township Board with the supervisor playing the active role.

(b) Horizontal dotted line represents absence of organized personal relations and presence of stereotyped attitudes.

5. SUPERVISOR-ADVISER:



Explanation:
TS = Township Supervisor
A = Adviser

*Superior n represents any number of persons.

(a) This relationship is shown in the shape of a wheel with the hub being in this case the Supervisor. This is a system of relations which he has developed and which he uses for various purposes. Its major characteristic is its informality and that the A's are also the "leaders." Being informal, others may, if they know how also utilize the same system. The failure of the Woodlawn Drive leadership to consult the A's was one of its mistakes. Each A is related to a group of people for whom he has some prestige and over whom he has "influence."

6. It should not be assumed that these diagrams exhaust the possible combinations For example after the election a woman from Woodlawn Drive (WD^1) called a Township Board member (BM^1) and asked him to reconsider. The Board Member (BM^1) then called TS to ask his opinion, who told BM^1 that the issue had been settled. When WD^1 called BM^1 for his decision she was told that the people had decided against zoning and it was best to drop the matter.

BAY, A NEW BARLEY VARIETY

By J. W. THAYER and E. E. DOWN
SECTION OF FARM CROPS

A NEW VARIETY of barley has recently been developed at Michigan State College. It is characterized by stiff straw, erect six-rowed heads, smooth red-tipped awns and good yielding ability. The variety has been given the name, "Bay," after one of the barley producing counties of the state.

In 1926 a cross was made at the Michigan Experiment Station between two barley varieties, Minnesota 450 and Spartan. Then followed 12 years of segregating, selecting, and testing to prove the worth of the material that resulted from the cross. By 1939 one selection, known as No. 07930, had shown sufficient promise to warrant testing in over-state plots.

In 1939 preliminary tests were carried on with Bay in five counties with six cooperators. The results of these trials together with those of following years, are presented in Table 1. The first three years' results of over-state testing showed that Bay did not yield quite so much as Wisconsin 38, but yield alone is not the only basis for judging the worth of a variety. Bay had a slightly higher test weight than Wisconsin 38, a stiffer straw, with ability to hold its heads better, and ripened 2 to 3 days earlier. These factors were judged to be of sufficient value to offset the slight decrease in yield.

Then came the poor barley years of 1943 and 1944. During these two years and again in 1945 Bay outyielded Wisconsin 38. Thus, after six years of testing, Bay was found to be the equal of Wisconsin 38 in yielding ability besides possessing the superior characteristics previously mentioned.

As the best cash barley market is for malting barley, any new variety should have malting characteristics at least equal to Wisconsin 38 and acceptable to the malting trade. In order to determine the malting characteristics of Bay barley, composite samples of both Wisconsin 38 and Bay were sent each year to the Wisconsin Experiment Station to be tested in the regional malt laboratory located there. The reports from these tests have been favorable to Bay.

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TABLE 1—*Comparative data for Wisconsin 38 and Bay barley obtained from over-state tests and the Michigan Agricultural Experiment Station.*

Year and variety	Over-state results			Experiment Station results	
	Bushels per acre	Test weight	Number of trials	Date headed	Plant height
Season 1939					
Wisconsin 38	27.6	43.5	6	6/22	29
Bay	25.4	44.4	6	6/15	26
Season 1940					
Wisconsin 38	43.0	46.2	7	6/30	32
Bay	41.9	48.3	7	6/19	35
Season 1942					
Wisconsin 38	50.5	45.4	24	6/22	33
Bay	48.3	45.0	24	6/17	35
Season 1943					
Wisconsin 38	18.2	—	4	—	—
Bay	23.6	—	4	—	—
Season 1944					
Wisconsin 38	29.2	45.7	5	6/28	32
Bay	33.8	46.2	5	6/26	32
Season 1945					
Wisconsin 38	44.2	43.2	4	6/21	—
Bay	45.5	44.3	4	6/21	—

To determine further the acceptability of Bay to the malting trade before releasing it as a variety, the Station decided in 1944 to have a pilot lot run through a regular malt house. For this purpose 500 bushels of Bay, together with 500 bushels of Wisconsin 38, were produced in 1944 in the Thumb section. These lots of barley were handled in the regular way by a malt house and eventually each individual lot of malt was used for brewing. The results from this test proved Bay to be as acceptable for malting purposes as Wisconsin 38 and possibly superior in some respects.

Bay barley was grown under the supervision of the Michigan Crop Improvement Association during 1945 on 350 acres. A limited supply of seed was available for sowing in 1946. Much of this crop is being grown for certification, but by the spring of 1947 seed should be available in almost unlimited quantities.

DDT RESIDUES ON FRUITS AND VEGETABLES[1]

By GLORIA D. MANALO, RAY HUTSON and ERWIN J. BENNE[2]
SECTIONS OF ENTOMOLOGY AND AGRICULTURAL CHEMISTRY

ONE OF THE IMPORTANT wartime discoveries was the effectiveness of 2, 2 bis (p-chlorophenyl) 1, 1, 1, trichlorethane, commonly known as DDT, as an insecticide. Although this compound has been known for 70 years its action against insects was not observed until 1939 (1) when it was tested experimentally against the Colorado potato beetle.

During the war DDT was used against numerous insect pests including body lice and mosquitoes, and because of the urgent needs of the armed forces for effective insecticides, all of the DDT produced in the nation was under government priority. Now, however, it is available to civilians, and the great amount of publicity given DDT has created much enthusiasm for using it as an insecticide for peacetime purposes. Since it is toxic to human beings, livestock and beneficial insects as well as to harmful insect pests (2), much work by impartial agencies is necessary to determine how it can be used effectively but safely; hence, it seemed of value to undertake a study of the residue aspect of this subject. Accordingly, during the latter part of the summer of 1945 the Sections of Entomology and Agricultural Chemistry began a collaborative investigation to determine the amount of DDT remaining on fruits and vegetables which had been sprayed or dusted with this insecticide. The preliminary findings are reported in this paper.

Since the discovery of the insecticidal properties of DDT, various bureaus of the U. S. Department of Agriculture, as well as numerous other national, state, municipal and commercial agencies, have conducted many and extensive tests to determine its effectiveness as an insecticide against a great variety of insect pests on crops, on animals, in buildings, swamps, parks, etc. Consequently, a very copious literature on DDT has accumulated in a surprisingly short time. However, in a publication of this kind it seems sufficient to cite a few important articles. Gunther (1), Annand (3), and Cristol and Haller (4) have

[1]This investigation was supported in part by a grant-in-aid from the Michigan Chemical Company of St. Louis, Michigan.

[2]The authors gratefully acknowledge the advice and aid given this project by other colleagues in both departments and the cooperation of various growers.

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given excellent reviews on the general aspects of DDT. Analytical methods for the determination of DDT have been reported by Hall, *et al.* (5), Gunther (6), Bailes and Payne (7), Stiff and Castillo (8), and Schechter, *et al.* (9). Certain of these methods have been modified for the determination of DDT in foods and biological materials (10, 11, 12, 13, 14, 15) to provide information on the possibility that toxic quantities of the insecticide may remain as a hazard on food products previously treated.

EXPERIMENTAL

All of the fruit and vegetable samples studied were secured by members of the Section of Entomology from crops that were sprayed or dusted with DDT under field conditions (treatment intervals averaged 2 weeks). The kinds of crops investigated and the treatments they received are given in Tables 1 and 2. Control samples which had received no DDT were provided for each kind of fruit and vegetable. No special precautions to prevent removal of DDT were taken in harvesting and handling the samples since it was assumed that comparable losses would occur in commercial practice.

DDT was removed from the samples by extracting weighed portions with benzene. Grapes were picked from the stems and weighed into a quart fruit jar. An appropriate volume of benzene was added, shaken repeatedly with the fruit, and drained off into a suitable receptacle. This was repeated twice with portions of fresh solvent to insure complete extraction of the DDT. Blueberries were handled in a similar manner.

A few samples of apples were weighed and peeled, and the peelings extracted with benzene as described above. The remaining samples of apples and all samples of peaches were weighed and washed with benzene contained in shallow dishes. To insure complete extraction of the DDT the fruits were brushed with a soft brush while in the benzene, then removed and rinsed in a second dish containing fresh solvent.

A representative portion of each vegetable sample was selected, weighed into a fruit jar, and extracted with benzene as described for grapes. The green bean pods and the leaves were picked from the plants and extracted separately. The cauliflower head, stripped of all the outer leaves was taken as one sample, and the tender stalks without the leaves constituted another. The celery was divided into mature stalks and leaves and young stalks and leaves, and appropriate samples of each were selected. The sample of the latter was washed with water after weighing to remove dirt in a manner simulating preparation of celery for the table. The sample of the former was not washed. The mature green leaves covering the cabbage head were removed and

discarded as a cook does, and samples of the inner and outer leaves were selected from the remainder. Another sample of cabbage taken at a later date consisted of a whorl of small heads surrounded by mature leaves. This was divided into two portions, one consisting of the outermost leaves and the other of the small heads, and each was analyzed separately. Samples of mature and of young leaves were selected from the turnip tops, and the latter sample was washed with water before extracting with benzene.

Control samples of each fruit and vegetable which had received no DDT were treated in a corresponding manner in order to correct for interference of extraneous material extracted by the benzene.

All benzene extracts were dried with anhydrous sodium sulfate and filtered to remove undissolved solids. The solutions were concentrated to convenient volumes and aliquots were analyzed for DDT.

Exploratory investigation of methods available for determining DDT indicated that the colorimetric xanthydrol-potassium hydroxide- pyridine method of Stiff and Castillo (8) was most suitable for evaluating the minute amounts of DDT present in the benzene extracts. Accordingly, the method was adapted for use with a Cenco-Sheard-Sanford Photelometer using a No. 401 Corning glass light filter of standard thickness, and applied to the analysis of the benzene extracts. The results obtained are given in Tables 1 and 2.

DISCUSSION

Careful consideration of various factors and conditions is necessary to enable one to understand clearly and interpret correctly the results obtained in this investigation. In the first place the fruits were at varying stages of maturity when sampled. Only two of the samples of grapes, those sprayed with DDT in bordeaux, and the Hale peaches were ripe enough to harvest. Many of the others were still green and immature; hence, they would not have been harvested for two or three weeks. This would undoubtedly cause the amounts of DDT remaining when the fruits reached the consumer to be different from the determined values.

All of the vegetables except the cauliflower were ready for harvest when sampled; however, some of the samples taken at the conclusion of the experiment were severely frozen. These tissues became soft and slimy when they thawed, thereby increasing the difficulty of effectively extracting the DDT from them. Since DDT seems to be lost quite rapidly at higher temperatures, samples cannot be preserved by drying as is often convenient when heat-stable constituents are to be determined. Consequently, it was necessary to extract the DDT as soon as the samples reached the laboratory.

Table 1.—*Fruits.*

Kind of fruit	Variety	Treatment[1]	DDT last applied	Samples collected	DDT determined, mgs. kg. of fruit
Blueberries	Rubel	2 dustings: 10% DDT	7-24-45	9-3-45	0.86
Blueberries	Rubel	2 dustings: 5% DDT	7-24-45	9-3-45	0.33
Grapes	Concord	2 sprays: 4 lb., 25% DDT. First spray immediately after bloom	8-15-45	9-7-45	1.19
Grapes	Concord	4 sprays: 3 lb., 25% DDT. 3 sprays at 2 weeks' interval. First spray immediately after bloom	8-15-45	9-7-45	7.12
Grapes	Concord	4 sprays: 3 lb., 25% DDT in Bordeaux	7-24-45	9-7-45	1.80
Grapes	Delaware	4 sprays: 3 lb., 25% DDT in Bordeaux	7-24-45	9-7-45	2.82
Peaches	Hale	2 sprays: 4 lb., 25% DDT	7-10-45	9-14-45	1.56
Peaches	Gage Elberta	2 sprays: 4 lb., 25% DDT	7-10-45	9-14-45	2.48
Peaches	Elberta	2 sprays: 3 lb., 25% DDT	8-22-45	9-10-45	0.39
Peaches	Elberta	1 spray: 3 lb., 25% DDT. Sprayed twice with sulfur between Aug. 20 and picking date	8-20-45	9-10-45	2.28
Peaches	Elberta	2 sprays: 3 lb., 25% DDT. Sprayed twice with sulfur between Aug. 20 and picking date	8-20-45	9-10-45	1.56
Peaches	Elberta	3 dustings: 10% DDT	8-19-45	9-7-45	4.39
Peaches	Elberta	3 dustings: 5% DDT	8-19-45	9-7-45	3.67
Apples	Jonathan	4 sprays: 2 lb., BL-155 containing 17% DDT + 1½ qt. oil	9-1-45	9-14-45	0.88
Apples	Jonathan	4 sprays: 3 lb., BL-155 containing 17% DDT at 2 weeks' interval	9-1-45	9-14-45	0.60
Apples	Wealthy[2]	3 sprays: 2(lead + 2 lb., 25% DDT + 1 lb. wettable sulfur); 1 spray, 4 lb., 25% DDT	8-22-45	9-3-45	0.34
Apples	Wealthy[2]	4 sprays: 3 lb., 25% DDT	8-22-45	9-3-45	2.00
Apples	McIntosh	3 sprays: 4 lb., 25% DDT	8-26-45	9-21-45	1.23
Apples	McIntosh	4 sprays: 2 lb., 25% DDT + 3 lb. lead	8-26-45	9-21-45	0.28
Apples	McIntosh	7 sprays: 4 lb., 25% DDT	8-29-45	9-21-45	1.67
Apples	Grimes	3 sprays: 5 lb., 25% DDT	8-17-45	9-21-45	3.39
Apples	Winter Banana	3 sprays: 2½ lb., 20% DDT + 2 lb. lead	8-17-45	9-21-45	0.66
Apples	Spy	3 sprays: 5 lb., 20% DDT	8-17-45	9-21-45	1.31
Apples	Grimes	5 sprays: 4 lb., 25% DDT	8-26-45	9-21-45	3.20
Apples	Grimes	5 sprays: 2 lb., 25% DDT + 3 lb. lead	8-26-45	9-21-45	1.43
Apples	Jonathan	4 sprays: 4 lb., 25% DDT + miscible oil	8-22-45	9-24-45	0.35
Apples	Jonathan	7 sprays: 4 lb., 25% DDT	9-1-45	9-24-45	3.32
Apples	Jonathan	7 sprays: 1 lb., 25% DDT + 3 lb. lead	9-1-45	9-24-45	0.99
Apples	Steele's Red	2 sprays: 4 lb., 25% DDT	7-4-45	10-5-45	1.03
Apples	McIntosh	2 sprays: 4 lb., 25% DDT	7-4-45	10-5-45	1.16

TABLE 1—*Continued.*

Kind of fruit	Variety	Treatment[1]	DDT last applied	Samples collected	DDT determined, mgs./kg. of fruit
Apples	Greening	2 sprays: 4 lb., 25% DDT	7- 4-45	10- 5-45	0.67
Apples	Tallman Sweet	2 sprays: 4 lb., 25% DDT	7- 4-45	10- 5-45	0 53
Apples	Jonathan	2 sprays: 4 lb., 25% DDT	7- 4-45	10- 5-45	0.73
Apples	Wagener	2 sprays: 4 lb., 25% DDT	7- 4-45	10- 5-45	0 96
Apples	Grimes	2 sprays: 4 lb., 25% DDT	7- 4-45	10- 5-45	0.78
Apples	Winter Banana[3]	4 sprays: 3 lb., 25% DDT	9- 1-45	9-14-45	2 25
Apples	Winter Banana[4]	4 sprays: 3 lb., 25% DDT	9- 1-45	9-14-45	1.68
Apples	Sutton's Beauty[3]	4 sprays: 3 lb., 25% DDT	9- 1-45	9-14-45	1 86
Apples	Sutton's Beauty[4]	4 sprays: 3 lb., 25% DDT	9- 1-45	9-14-45	0 62
Apples	Jonathan[3]	4 sprays: 3 lb., 25% DDT	9- 1-45	9 14-45	3 19
Apples	Jonathan[4]	4 sprays: 3 lb., 25% DDT	9- 1-45	9-14-45	0 97
Apples	Jonathan	9 sprays: 3 lb., lead. No DDT tested for drift from plots alongside	9- 1-45	9-14-45	0 05
Apples	Jonathan	9 sprays: 3 lb., lead. No DDT tested for drift from plots alongside	9- 1-45	9-14-45	none
Apples	McIntosh	4 sprays: 5 lb., 20% DDT	8-25-45	9-14-45	0 67
Apples	Golden Delicious	4 sprays: 5 lb., 20% DDT	8-25-45	9-14-45	2 33
Apples	Delicious	5 sprays: first and second, 2 lb., 25% DDT + 3 lb. lead; third and fourth, 1 lb., 25% DDT + 3 lb., lead; fifth, 4 lb., 25% DDT + 3 lb., lead	8-22-45	9-14-45	0 38
Apples	Jonathan	4 sprays: 2½ lb., 20% DDT	8 22 45	9-14-45	0 66
Apples	Steele's Red	4 sprays: 2½ lb., 20% DDT	8-22-45	9-14-45	0 64
Apples	Spy	4 sprays: 4 lb., 20% DDT	8-22-45	9-14-45	0.69
Apples	Jonathan	4 dustings: 5% DDT	8-22-45	9-14-45	0 53
Apples	Wealthy	9 sprays: 3 lb., 25% DDT	8-20-45	9-10-45	1.66

(1) In all sprays the weights given are per 100 gallons of water.
(2) Apples peeled and peelings extracted.
(3) Samples taken from outer portion of tree.
(4) Samples taken from inside portion of tree.

Table 2—*Vegetables.*

Kind of vegetable	Portion analyzed	Treatment	Last dusted	Samples collected	DDT determined, mgs./kg. of vegetable
String Beans	Green bean pods	2 dustings with 1% DDT	8–6–45	8–13–45	0.32
String Beans	Leaves	2 dustings with 1% DDT	8–6–45	8–13–45	30.80
String Beans	Green bean pods	2 dustings with 3% DDT	8–6–45	8–13–45	2.02
String Beans	Leaves	2 dustings with 3% DDT	8–6–45	8–13–45	98.80
String Beans	Green bean pods	2 dustings with 5% DDT	8–6–45	8–13–45 after 2 hard rains	2.90
String Beans	Leaves	2 dustings with 5% DDT	8–6–45	8–13–45	206.80
Cabbage	Inner leaves	1 dusting with 5% DDT	11–3–45	11–6–45	0.91
Cabbage	Outer leaves	1 dusting with 5% DDT	11–3–45	11–6–45	0.41
Cabbage	Small heads	1 dusting with 5% DDT	11–3–45	11–24–45	5.96
Cabbage	Outermost mature leaves	1 dusting with 5% DDT	11–3–45	11–24–45	21.13
Cauliflower	Head	1 dusting with 5% DDT	11–6–45	11–24–45	0.60
Cauliflower	Tender stalks	1 dusting with 5% DDT	11–6–45	11–24–45	0.79
Celery	Tender stalks and leaves	1 dusting with 5% DDT	11–3–45	11–6–45	0.50
Celery	Mature stalks and leaves	1 dusting with 5% DDT	11–3–45	11–6–45	13.16
Celery	Tender stalks and leaves	1 dusting with 5% DDT	11–3–45	11–24–45	1.22
Celery	Mature stalks and leaves	1 dusting with 5% DDT	11–3–45	11–24–45	1.62
Turnip tops	Young tops	1 dusting with 5% DDT	11–3–45	11–6–45	17.34
Turnip tops	Mature tops	1 dusting with 5% DDT	11–3–45	11–6–45	14.47
Turnip tops	Young tops	1 dusting with 5% DDT	11–3–45	11–24–45	5.83
Turnip tops	Mature tops	1 dusting with 5% DDT	11–3–45	11–24–45	4.79

Benzene was chosen as the extracting solvent for a number of reasons. It dissolves DDT freely, is readily obtainable at a reasonable price, and can be conveniently recovered from the extract for further use. However, this solvent is toxic and inflammable and safety precautions are necessary in handling it.

In selecting the method for determining DDT residues, it was necessary to choose one that was sufficiently sensitive to make possible the evaluation of minute quantities of the insecticide and to detect small differences in concentration. Of the various methods investigated the xanthydrol-potassium hydroxide-pyridine (8) and the nitration (9) procedures are suitable for the determination of micro quantities of DDT. The former method is relatively simple and rapid and was quite readily adaptable to the equipment available, but the offensive odor of pyridine offered a serious objection to its use. However, carrying out the reaction in long, narrow test tubes helped to prevent excessive dissipation of pyridine into the laboratory atmosphere, and the method was used throughout the investigation.

In spite of all precautions taken, interference from extraneous substances extracted from the samples by the benzene could not be entirely avoided. This was especially true of chlorophyll which had a strong tendency to mask the pink of the reaction color. Sulfur sprayed onto the peach samples as a fungicide was removed by the benzene and likewise interfered with the determination. The use of small aliquots and analysis of control samples for each kind of material analyzed helped to minimize these interferences.

As will be noted from the tables the amounts of residual DDT in the crops investigated varied widely. Among the fruits only one sample of Concord grapes contained DDT in excess of the tolerance tentatively set by the U. S. Food and Drug Administration at 7 milligrams per kilogram of fruit. This crop received four sprays, and the sample was taken three weeks after the last application. It is of interest to note that the two samples of apples which were tested to determine whether DDT had drifted onto them when adjoining plots were treated contained practically none of the insecticide.

The situation was different, however, with respect to the vegetable crops, several of which contained comparatively large quantities of DDT. Although the green bean pods contained but little of the insecticide, the leaves from the same plants contained as much as 206 milligrams per kilogram. The small amount of residual DDT on the green bean pods was undoubtedly due to the fact that they developed enormously after the insecticide had been applied. Although the leaves do not constitute the portion of the bean plant used for human food, the

results indicate that it would be dangerous to use them as roughage for livestock. This would apply likewise to the small heads and outermost leaves of the cabbage since these portions are frequently fed to rabbits or other animals after the main head is harvested. Also, they might constitute a menace to wild rabbits and birds if left standing in the field. The mature stalks and leaves of celery and both the mature and young turnip tops gathered three days after dusting contained excessive quantities of DDT; however, after 22 days these amounts had decreased appreciably. Nevertheless, great caution should be observed with respect to the use of DDT on the parts of vegetables used as food.

Variations in weather conditions, in the manner of applying the insecticide and in the handling of the fruits and vegetables are among numerous factors that make it difficult to determine the relation between the number of treatments and the amount of residual DDT. Moreover, the changes which DDT undergoes under field conditions and in mixtures with other insecticides and fungicides have not been definitely determined and yet would unquestionably affect the amounts of DDT remaining on the fruits and vegetables. Obviously, the amount of the residue is also dependent on the time interval between the last application of the insecticide and the harvesting of the crops.

This investigation showed conclusively that DDT sprays and dusts left varying amounts of residue which did not bear any direct quantitative relationship to the number of applications. Moreover, the amount of residual DDT did not decrease proportionately with the length of time elapsing between the last application and harvest. Hence, analysis for the amount of DDT in a food is the only safe guide for determining whether it is fit for human consumption. The development and adaptation of methods for the chemical determination of DDT have not kept pace with the extensive investigations of its effectiveness as an insecticide. There are still numerous aspects of the residue problem that require further investigation. Therefore, it should be emphasized that those contemplating the use of DDT should be very careful not to digress from the directions given by the manufacturer and to use it only as recommended by reliable authorities.

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KEEPING THE LAYING HOUSE FULL

By J. A. DAVIDSON, C. M. McCRARY and C. G. CARD
SECTION OF POULTRY HUSBANDRY

A MAJOR PROBLEM confronting all farmers and poultrymen who depend upon market eggs for a sizable portion of income is the replacement of hens which have died or stopped laying. In the Quarterly Bulletin for February 1944, a project entitled, "Off-Season Pullets," was reported, giving results of White Rocks hatched in October 1942. In this trial the results were not satisfactory because of the low egg production.

It was believed desirable to continue work on this management procedure using White Leghorns since it would be possible to compare their production with March and April hatched pullets of similar breeding. Thus, in connection with some work in which sulfur and fish meal was used in broiler feeds White Leghorns were included with the idea of retaining a portion of the pullets during the following spring and summer months for egg production. These tests were conducted at the Michigan State College W. K. Kellogg Farm at Augusta, where a suitable permanent brooder house was available for growing chicks at any season of the year.

BROODING

In October 1944, 836 straight-run White Leghorn chicks were placed under three electric brooders. On January 10, 1945, 252 pullets were selected for the purpose of keeping them for egg production. At 14 weeks of age these pullets averaged 2.36 pounds per bird. If sold as broilers at 28 cents a pound they would have had a value of 66 cents each. An average of 16.5 pounds of feed had been consumed per bird, indicating a requirement of 7 pounds of feed to produce each pound of meat for this group of Leghorns.

FEED CONSUMPTION FROM JANUARY 10 TO MARCH 1, 1945

The pullets ate during this period 869 pounds of corn and wheat, 80 pounds of oats, 1,931 pounds of laying mash and 5 pounds of oyster shells. This amounted to 11.5 pounds of feed per bird, for a total of 28 pounds of feed per bird to approximately 20 weeks of age.

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RESULTS

Table 1 shows that during the 7 months' period from March 1 to September 30, the March-hatched bird produced 146 eggs each, the April-hatched bird produced 150.5 eggs, and the October-hatched bird produced 101.7 eggs. These figures were computed on a hen-day basis. They also show that there was little difference in the amount of feed required to produce a dozen of eggs, if the March feed consumption is eliminated from the October-hatched birds, when only 191 eggs were produced. The amount of feed to produce a dozen eggs was 5.47 pounds, 4.96 pounds and 5.60 pounds for the March-, April- and October-hatched birds, respectively. These differences are possible between groups of similar ages.

Table 2 compares the egg production, mortality and culling beginning with the sixth month after hatching. It must be remembered that these ages occur at different seasons of the year. The total removed by deaths and culling was 24.85 percent for the March-hatched, 21.89 percent for the April-hatched and 26.68 percent for the October-hatched, between 6 and 12 months of age. Again, we might expect this much variation between groups of the same age.

During this period on a hen-housed basis, the March-hatched birds averaged 99.48 eggs, the April-hatched birds averaged 110.84 eggs, and the October-hatched averaged 89.15 eggs.

Table 3 shows the percent of the various feed constituents consumed by the different groups. There is considerable variation, part of which is due to the different seasons of the year, with no attempt to control the ration of feed constituents except by limiting the grain. This should be more carefully controlled in any future trials.

Table 4 gives the number of birds in the laying house at the beginning of each month from October 1, 1944, to September 30, 1945. This includes the pullets from chicks hatched in February and March 1945 and the egg production from these birds as well. This was done in an attempt to secure not fewer than 1,000 to 1,100 eggs per day from the 2,000-2,200 housing capacity. Owing to a shortage of labor on the farm at the necessary times and an outbreak of "blue-comb" or "pullet disease," the goal was not attained during July, August and September. The total egg production for the year was 403,308 which is an average of 1,104 eggs per day.

DISCUSSION

The egg production for the so-called "off-season" pullets (October-hatched) was reasonably satisfactory, although somewhat lower for the same period when compared with birds hatched during the spring

TABLE 1—*Feed consumed per bird for each dozen of eggs, with average egg production per bird.*

Month	March-hatched 1944			April-hatched 1944			October-hatched 1944		
	Pounds feed per bird	Pounds feed per dozen	Number eggs per bird	Pounds feed per bird	Pounds feed per dozen	Number eggs per bird	Pounds feed per bird	Pounds feed per dozen	Number eggs per bird
1945									
March	10.5	5.60	22.6	10.3	5.22	23.8	7.0	.....	0.7
April	8.9	5.01	21.4	8.6	4.62	22.5	7.0	10.92	7.6
May	9.5	5.28	21.5	9.5	5.30	21.7	7.9	6.50	14.5
June	9.1	5.53	19.7	8.4	4.82	21.0	8.0	4.90	19.6
July	8.9	5.13	20.9	8.2	4.39	22.4	8.2	4.73	20.6
August	9.3	5.38	20.7	9.4	5.33	21.3	8.1	4.68	20.7
September	9.8	7.46	19.2	7.9	5.11	17.8	6.9	4.60	18.0
TOTAL	56.2	5.47	146.0	62.3	4.96	150.5	53.1	6.49	101.7

TABLE 2—*Egg production, mortality and culling percentages at similar ages.*

Month	March-hatched 1944			April-hatched 1944			October-hatched 1944		
	Percent			Percent			Percent		
	Production	Died	Culled	Production	Died	Culled	Production	Died	Culled
6th	47.7	1.75	0.00	45.4	0.99	0.00	25.5	1.59	0.80
7th	70.6	2.34	0.00	72.9	1.54	0.00	46.9	2.39	0.00
8th	68.5	2.44	0.09	70.5	1.76	3.74	65.4	3.19	0.00
9th	65.9	2.34	7.80	69.9	1.87	4.07	66.6	1.59	5.58
10th	67.7	1.27	3.41	74.4	2.09	2.42	66.8	0.00	5.98
11th	66.6	1.46	1.95	76.7	1.98	1.43	60.2	0.00	8.76
TOTAL	65.4	11.60	13.25	68.5	10.23	11.66	54.34	8.76	17.92

TABLE 3—*Feed consumption—distribution in percent during similar ages.*

Month	March-hatched 1944					April-hatched 1944					October-hatched 1944				
	Wheat and corn	Oats	Mash	Pellets	Shell	Wheat and corn	Oats	Mash	Pellets	Shell	Wheat and corn	Oats	Mash	Pellets	Shell
6th	39.02	11.53	46.14	.....	3.29	34.24	9.59	52.55	.....	3.61	38.46	5.47	54.06	.....	2.01
7th	40.84	8.80	46.44	.....	3.90	31.51	9.91	54.09	0.16	4.31	40.24	2.89	51.84	0.83	4.20
8th	38.85	7.52	49.70	0.20	3.69	34.57	7.31	50.78	2.92	4.39	31.89	3.97	57.15	4.87	2.11
9th	37.11	6.88	49.03	8.18	3.77	34.51	8.52	48.13	4.63	4.19	31.42	3.09	55.42	6.97	3.09
10th	35.60	8.44	47.13	5.09	3.72	35.72	9.80	42.32	7.37	4.76	29.55	4.72	55.26	7.72	2.75
11th	34.85	7.77	47.27	6.28	3.81	33.00	11.99	42.19	7.05	5.75	30.77	6.87	48.81	10.98	2.56

TABLE 4—*Eggs produced by months.*

Month	Birds beginning	Number of eggs	Eggs per bird
October	2068	36,927	17.8
November	2026	42,161	20.8
December	1984	39,418	19.8
January	1825	37,491	20.5
February	1708	32,701	19.1
March	1633	36,401	22.2
April	1796	34,627	19.2
May	1715	34,454	20.0
June	1658	32,339	19.5
July	1511	26,816	17.7
August	1177	24,527	20.9
September	1265	25,446	20.1
Total	——	403,308	237.6

months. They contributed 21,781 eggs during the late spring and summer months, when production is at a low point owing to deaths and culling. It must be remembered that these birds were reared entirely indoors and have been compared with range reared stock. They laid at a rate capable of giving better than 180 eggs per bird per year which is above the average for the state. Unfortunately, we were unable to keep them separate during the fall and winter of 1945-46 so that it is impossible to say how well they laid during that time. One hundred and seventy of the October-hatched birds were kept with about 100 March-hatched birds, and the production until February 1, 1946 was over 50 percent. All-night lights were used on these birds.

It is also probable that these birds were not properly fed since an examination of Table 3 shows that they ate considerable more mash at a comparable age than was consumed by normal season birds. This is a problem in feeding and management that should be investigated.

It is evident that "off-season" pullets can be successfully reared and will produce reasonably well. This makes possible more efficient utilization of labor, equipment, and the laying house. The problem of intestinal parasites is less, and the problem of respiratory diseases was not encountered.

Better schedules for starting chicks may be worked out than those reported here which were March, April, October, February and March. On some commercial poultry farms January, April and September are the months commonly included in the schedule particularly if hatching eggs are wanted. It would seem that this scheme might be followed on farms having laying house capacity similar to that at the W. K. Kellogg Farm.

In Table 3, it will be noted that pellets were used and that the percentage consumed is listed. They were used in the manner usually fol-

lowed when wet mashes are used as a feeding practice. For the most part they were made from a breeder mash and guaranteed to contain 20-percent protein. The laying mash was an 18-percent protein mash.

Pellets are more convenient to use than a wet mash since less labor is involved for the poultryman. They apparently substitute nicely for a wet mash when that practice is deemed advisable.

Closer culling should be followed under this off-season system of management. This would seem very desirable since the loss from deaths was less from the October-hatched birds as more were culled (Table 2). Mortality is considerable in the average farm flock, many of which could be salvaged by closer attention to culling.

SUMMARY

The production of October-hatched White Leghorns compared favorably with normal-season-hatched, range-reared chicks.

This procedure in management should aid in efficient production with proper feeding.

The cost of rearing off-season pullets is slightly higher, owing to increased feed consumption. Problems arising from intestinal parasites may be less.

More work should be done on the best schedule and feeding practices.

CONTROL OF ANTHRACNOSE ON CANNERY TOMATOES; TWO YEAR'S RESULTS

By D. M. McLEAN and E. H. BJORNSETH
SECTIONS OF BOTANY AND HORTICULTURE

THE ANTHRACNOSE DISEASE of tomato is caused by a parasitic fungus, *Colletatrichum phomoides* (Sacc.) Chester. This disease is considered to be the most destructive fruit disease of tomato in the more important canning areas of the East (4). It causes considerable loss annually also in Indiana, Ohio, and Michigan. It is particularly severe in Michigan in areas where tomatoes are grown for the canning industry and seems to be increasing in intensity.

The economic loss due to this disease is fully as great to the canner as it is to the grower. Anthracnose fruit rot occurs every year in fields where tomatoes are permitted to ripen on the vines. It is likely to be severe in commercial fields in Michigan when excessive rainfall occurs during the ripening season. Usually, it does not appear until late August or in September. The disease has been observed on a variety of soils, but seems to occur most frequently on light sandy loams (1). It develops in many fields where all the approved cultural practices have been rigidly observed. More often environmental conditions that favor foliar diseases of tomato plants also cause the development and spread of anthracnose. The disease usually is more severe on fruits which ripen on plants showing severe Alternaria or Septoria leaf-spot infections, or which are partially defoliated by other causes.

The disease is most prevalent in fields that have been planted repeatedly to tomatoes (4). The causal organism apparently overwinters in refuse from diseased plants (4, 6, 10); however, the disease may be severe on tomatoes grown on new soil.

Anthracnose, essentially, is a disease of the tomato fruit. The fungus may cause a leaf spot disease on the foliage but the lesions are inconspicuous and this injury is considered relatively unimportant (4). The fruit spot starts as a rather inconspicuous, circular, translucent, slightly sunken blemish on the ripe or nearly ripe fruits, as the smaller lesions shown in Fig. 1. The lesions rapidly increase in size as the fruit ripens. The ultimate size of the spot may vary from one-fourth

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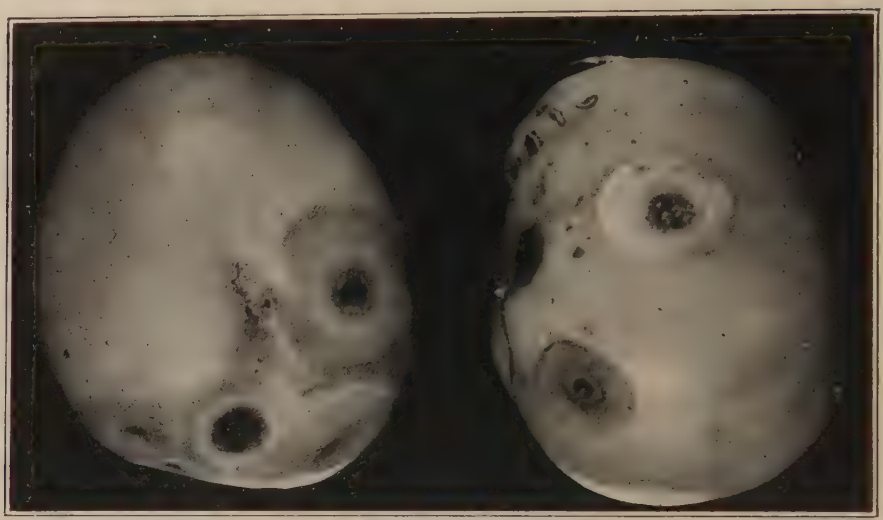

Fig. 1. Tomato anthracnose. Photo: M. C. Strong.

to one inch in diameter. Often large spots coalesce, causing larger water-soaked areas. Infections usually are more numerous at the stylar end (blossom end) of the fruits and on the lower fruits on the vine, particularly those in contact with the soil. Apparently, the causal fungus does not invade the green fruits under ordinary conditions. Red-ripe tomatoes which have been carefully picked, placed in hampers preparatory for delivery to the canner and allowed to stand overnight, frequently are so badly spotted with anthracnose the following morning that they must be re-sorted to be acceptable at the grading station.

A uniform, concentric zonation or target-like appearance of older lesions is caused by the periodic formation of black fruiting bodies of the fungus beneath the epidermis of the fruit. Twenty-four to forty-eight hours after a spot appears, the center may become dark-brown to blackish in color (Fig. 1). Cream-colored, pink, or brown spore masses may ooze from the center of the fruit spot during periods of high humidity. These spores are splashed about by rains and infect surrounding fruit. The epidermis remains intact over the lesions.

The fungus usually penetrates deeply into the flesh, and thousands of spores may be present beneath a single fruit lesion. Although infection in the field may not be severe, it markedly reduces the grade of No. 1 fruits to the grower and is even more serious to the canner since it involves additional work to remove the fruit blemish and contributes very materially to an abnormally high mold count. According to the canner's grade, a single anthracnose lesion causes infected

fruits to be considered as culls. To the processor, the primary concern is the amount of fungus growth and spores within the fruit.

For several years, it has been observed that the anthracnose disease is less common on sprayed plants than on unsprayed ones in the same field where the fungicidal applications were applied and timed primarily for the control of foliar diseases (1, 4, 5, 8, 9).

Bordeaux mixture reduces the injury to a considerable extent. Some of the fixed copper materials are also quite effective. However, various copper-containing fungicides have failed to control anthracnose even when control of foliar diseases was good (3, 10, 11). None of these materials has given adequate control of the disease.

It was not until 1941-1942 when a new fungicidal material, Fermate (ferric dimethyl-dithiocarbamate), gave such outstanding control of anthracnose (3, 4, 10) that specific experimentation was begun for the purpose of controlling this disease. It was noted early, however, that Fermate is not so efficient as some of the copper-containing materials in the control of foliar diseases of tomato, commonly called "blights" (3, 10, 11). Experiments followed for the purpose of testing Fermate in combination with certain fixed-copper materials and by using Fermate and copper sprays in alternate applications in attempts to control defoliation caused by Alternaria and Septoria infections, as well as fruit rots (11). Also, it is necessary to study the correct timing of these fungicidal sprays for most efficient disease control.

The Ohio Agricultural Experiment Station in 1944 planned a ten-state cooperative experiment for the purpose of testing the relative efficiency of certain fungicidal sprays for the control of tomato anthracnose. Plant pathologists in Maryland, New Jersey, Delaware, Connecticut, Pennsylvania, Indiana, New York, Ohio, Illinois, South Dakota, and Michigan applied the same formula in the same schedule to artifically inoculated plots and to larger commercial uninoculated fields, under the direction of the Ohio station. This experiment included Fermate and Tribasic copper sulfate sprays used alone and in an alternating 5-application schedule. The results of the 1944 tests indicated that Fermate will give a definite reduction in the number of infected fruits (13). The alternating schedule gave best anthracnose control. Since drought conditions in late July and August inhibited the spread of the causal organism in most of these states in 1944, it was decided to continue the test for the control of this disease during the season of 1945. It is the purpose of this paper to report the results of the 1945 tests in Michigan.

In 1945, a new fungicide, Zerlate (zinc dimethyl-dithiocarbamate), was substituted for Tribasic copper sulfate when used alone in the 1944 schedule. The treatments were as follows:

1. Fermate, 2 pounds in 100 gallons of water (2-100).
2. Alternating applications of Fermate and Tribasic copper- sulfate or Microgel (4-100), starting and ending with Fermate in a 5-application schedule.
3. Zerlate, 2-100.
4. Untreated check.

A five-acre field of the Greater Baltimore variety, planted 3½ feet by 5½ feet, was selected in Lenawee County, Palmyra, Michigan, for the tests in a commercial planting.[1] These tomatoes were grown for the Acme Preserve Company. At the request of the grower who applied the spray materials bordeaux (8-4-100), likewise, was included in the experiment. The materials were applied with an eight-row power sprayer at the rate of 150 gallons per acre and at a pressure of approximately 300 pounds. Five applications were made at approximately 10-day intervals, starting July 18. The percentage of fruits showing one or more anthracnose lesions was determined from the total yield for each treatment. The data are presented in Table 1.

Five applications of Fermate (2-100) gave the best control of anthracnose. Five applications of Zerlate was nearly as effective as the Fermate treatment, followed by the alternate Fermate-Tribasic treatment. Bordeaux failed to control the disease. Alternaria blight caused considerable defoliation in the untreated plot after the third picking on September 19.

The data from this single test are not significant other than that they indicate that the Fermate and Zerlate treated plots were better than the bordeaux and untreated check plots.

TABLE 1 — *Effect of different sprays on the control of tomato anthracnose on Greater Baltimore tomatoes in 1945.*

Treatment	Percentage of culls	Pounds of ripe fruits showing anthracnose, per 50 plants	Percentage of ripe fruits showing anthracnose
No treatment	11.7	64.0	10.6
Bordeaux (8-4-100)	8.4	56.0	10.0
Zerlate (2-100)	5.5	7.5	1.5
Fermate (2-100), Tribasic (4-100), (alternate applications)	5.1	13.3	2.4
Fermate (2-100)	5.1	5.75	0.9

[1]The authors wish to acknowledge their indebtedness to Mr. Elwyn Isley, Palmyra, Michigan, and to Mr. Earl Kuney of the Acme Preserve Co. for their cooperation in these tests during the summers of 1944 and 1945.

TABLE 2—*Effect of different sprays on the severity of anthracnose on John Baer tomatoes in 1945.*

Treatment	Percentage of anthracnose on Sept. 18	Percentage of anthracnose on Sept. 26	Percentage of anthracnose in total yield	Percentage of defoliation on Sept. 11
No treatment	5.4	8.0	4.4	35
Zerlate + calcium arsenate (2-4-100)	3.1	4.0	1.7	14
Fermate + calcium arsenate (2-4-100) and Tribasic + calcium arsenate (4-4-100) alternating	0.0	2.8	1.7	7
Fermate + calcium arsenate (2-4-100)	3.4	9.3	4.2	23

The tests were, likewise, carried out in 1945 on the experimental farm at East Lansing. Two hundred plants of the John Baer variety, planted 4 feet by 6 feet, were divided into four lots and these were further divided into five 10-plant randomized replicates. The fungus which causes anthracnose was cultured on sterilized wheat and applied at the rate of 15 grams around the base of each plant on July 16. Sprays were applied with a power sprayer at approximately 150 pounds pressure. Calcium arsenate was used as an insecticide at the rate of 4 pounds in 100 gallons of spray material in each application. The four treatments listed above were used at approximately 10-day intervals in a five-application schedule, starting July 27.

The percentage of diseased fruits was determined at each picking. The data as presented in Table 2, on the incidence of anthracnose on September 18, and October 26, are not conclusive. The last fungicidal treatments were applied on September 6. There was practically no anthracnose present at the first picking on September 11; however, severe foliar infections by Alternaria had resulted. Fermate alone failed to control Alternaria blight and considerable defoliation resulted in this treatment as indicated in Table 2. Between September 18, and September 26, there was severe defoliation in the Fermate-treated plots, and the percentage of anthracnose fruits nearly doubled in this period. Serious infections of *Phytophthora infestans* also occurred during this period which further complicated anthracnose control. Zerlate gave considerably better control of foliar diseases and showed a correspondingly better control of anthracnose. The alternate applications of Fermate and Tribasic copper sulfate gave the best control of the blight disease and compared with Zerlate in control of anthracnose. Environmental conditions at East Lansing were very unfavorable for ripening tomato fruits during late August and September. The data in Table 2 are of interest, therefore, mainly because they present evi-

dence for the rather definite relationship which has been observed between defoliation and the percentage of fruits affected with anthracnose (11). The heavy infection in the Fermate plot followed a severe defoliation of the plants by alternaria and phytophthora blights.

Table 3 summarizes the data taken from 13 experiments in the cooperative anthracnose control project of 1945.[2] These data indicate that Zerlate gave the best control of anthracnose. The alternating schedule gave slightly better control of blight diseases than Zerlate and considerably better control than Fermate alone. Likewise, the percentage of culls was lowest in the alternating schedule and is reflected in a larger yield of marketable fruits.

On the basis of data obtained so far in these experimental trials, Fermate may be expected to give considerable control of anthracnose. Fermate, however, does not adequately control foliar diseases. It is indicated that Zerlate may be more efficient in controlling both the foliar diseases and the anthracnose disease. Since it is essential to control foliar diseases, as well as fruit rots of tomato, the manner in which Fermate or Zerlate should best be fitted into a general control schedule remains to be determined by further tests.

Different tomato varieties and the same variety planted on different dates differ in the periods for maturing ripe fruits. That, as well as seasonal variations in different years, suggests that spray schedules should be timed to correspond with stages of plant growth or fruit development. In general, the first application should be applied not later than 30 days after development of the first blossom cluster or when the fruits of the first cluster are about one-half to three-fourths of full size (11) and at approximately 10-day intervals in a five-application schedule.

TABLE 3—*Average percentage values for anthracnose, culls and foliage condition, and total and salable yields of tomatoes from 13 experiments in 1945.*

Treatment	Percentage of anthracnose	Percentage of foliage alive	Percentage of culls	Yields		
				Total pounds on 10 plants	Salable pounds on 10 plants	Salable in tons per acre
Fermate + calcium arsenate (2-4-100)	8.24	59	20.7	112	89	10.45
Zerlate + calcium arsenate (2-4-100)	6.82	71	20.0	116	93	10.92
Fermate and Tribasic alternating	7.49	73	16.4	115	96	11.28
No treatment	20.34	44	29.1	111	79	9.28

[2]Data submitted by Dr. J. D. Wilson, the Ohio Agricultural Experiment Station.

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A PRELIMINARY REPORT ON FARM POND MANAGEMENT IN MICHIGAN

By PETER I. TACK and W. F. MOROFSKY
SECTIONS OF ZOOLOGY AND ENTOMOLOGY

THIS PRELIMINARY REPORT is prompted by the considerable interest in use of commercial fertilizer to increase fish production in farm ponds, as evinced by the number of inquiries received. Most of the inquiries have been stimulated by popular accounts of the success of Swingle and Smith in increasing production of fish in Alabama farm ponds by combining the use of commercial fertilizers adapted to their water with careful management of the fish populations in their ponds.

Food has long been recognized as a limiting factor in the production of fish. W. C. Kendall (1924), in commenting on food supply for fishes, raises the question of limitation on fish production imposed by quantity and quality of food present. He quotes Pieters (1901) as follows: "barring enemies and artificial hindrances to increase, such as over fishing, fish will multiply up to the limit of the food supply, but cannot overstep that limit. If the food supply can be increased, an increase in the number of fish will naturally follow."

Smith and Swingle (1939) show a direct relationship between plankton and fish production in experimental ponds. Swingle and Smith (1939) show that addition of commercial fertilizers in proper proportions increases the phytoplankton production. It is also apparent from the results presented in this paper that the fertilizer must be adapted to the water on which it is to be used.

Smith and Swingle (1939) state, "Under natural conditions most fish are dependent, either directly or indirectly, on plankton for food. Some species, such as gold fish *(Carassius auratus)*, golden shiners *(Notemigonus crysoleucas)* and gizzard shad *(Dorosoma cepedianum)* use phytoplankton, along with various groups of organisms, for food. Others, like bluegill bream *(Lepomis macrochirus)*, small crappies *(Pomoxis nigro-maculatus* and *P. annularis)*, and small black bass *(Huro salmoides* and species of *micropterus)* feed on zooplankton and the larvae of various insects. These food organisms in turn, eat phytoplankton directly, or the bacteria that decompose phytoplankton and other organic matter. Large

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crappie and black bass feed on the smaller fish and are, therefore, indirectly dependent on plankton."

Swingle and Smith (1941), showed that the number of fish utilizing the increased amount of food produced in a pond by adding fertilizer had a marked effect on the growth rate of the fish. That is, the management of the population of fish in the pond is equal in importance to the addition of fertilizer.

The large number of natural lakes and ponds in Michigan accessible to the public for fishing and boating has caused much doubt about the value of fertilizing programs in this area, since we are not now harvesting the entire production. There are, however, in the experiments of Swingle and Smith, many implications bearing on fish production in our natural waters. In addition to this, there are some land owners who wish to have private ponds for multiple uses, one of which is now, fish production.

The results of the work in Alabama naturally raised the question of whether similar results could be obtained in Michigan, with due allowance for the difference in growing season. With this background the present project was started at Michigan State College.

LOCATION AND CONSTRUCTION OF PONDS

The experimental ponds were constructed on the Michigan State College Lake City Experiment Station. This Station is situated in the West Central portion of Missaukee County about 15 miles northeast of Cadillac. A small stream known as Mosquito Creek rises on the northwest portion of the Experiment Station property and flows diagonally in a southeasterly direction for approximately a mile before leaving the property. This stream was dammed near the upper end to form a reservoir with sufficient head to fill the experimental ponds. The experimental ponds were then laid out and constructed on the downstream side of the reservoir dam, and on either side of the original stream. This arrangement permitted filling the ponds from the reservoir and also draining them into the old stream channel.

Construction was begun in the fall of 1943. The first two ponds of approximately one-half acre surface were completed about mid-July in 1944. Pond "B" (fertilized) was completed on July 1, 1944, and Pond "A" (control) on July 18, 1944.

These ponds were built on sandy soil overlaid with a mantle of muck. The muck was removed and fill brought in to make the dykes. The elevation and gradient of the land are such that the maximum depth

of the ponds is about 6 feet. A variation of about 2 or 3 inches has taken place as a result of the fluctuation of the water level in the reservoir.

The third and fourth ponds were made in the pit where fill for the first two ponds was obtained. They are designated as ponds "C" (control) and "D" (fertilized) and have a surface area of about 1,500 square feet. These ponds were completed in June 1945.

POND OPERATION IN 1944

The operation of the ponds in 1944 began rather late. The ponds, as previously mentioned, were not completed until in July. Pond "B", which is the experimental pond, was fertilized on July 12, 1944. Pond "A" was used as a control. The ponds were each stocked with 400 Bluegill Sunfish *(Lepomis macrochirus)* fingerlings with an average length of 1–7/16 inches on August 3, 1944.

Soon after stocking the ponds, Mr. Berridge, the station superintendent, reported seeing the young fish gasping at the surface. He stated this was especially noticeable in the early morning. This information, coupled with chemical analysis for oxygen, led us to expect a high mortality. This situation arose as a result of the abundant growth of weeds, both in the reservoir and in the ponds, prior to filling these basins. The decomposition of this material during the warm period of the summer apparently depleted the dissolved oxygen. It is noteworthy that when the ponds were drained in October none of the fish had survived in the control pond, while a small number (55) had survived in pond "B" which received fertilizer.

This situation was not entirely unexpected, but the late date of completion of the ponds, together with eagerness to start these experiments, precluded waiting to stock the pond until this vegetation had decayed. It is apparent, however, that such haste was not wise, and other pond owners would do well to wait until pond bottom vegetation had thoroughly decayed before stocking with fish.

Fertilizer was applied regularly at the rate of 100 pounds per acre, at intervals of 3 weeks, beginning on July 12, 1944, and continuing until September 15, 1944. The mixture used was nitrogen 10 percent in the form of synthetic urea, phosphorous 6 percent as superphosphate, and potassium 4 percent as muriate of potash. This mixture was selected arbitrarily to begin with, as there were no experimental observations to support the selection. After the ponds were filled, water was sent to the laboratory where Dr. R. L. Cook of the Soil Science Department, ran a series of tests in the greenhouse to determine the proper levels of fertilizer to use. The fertilizer formula for 1945 was based on this information.

TABLE 1—*Chemical analysis in parts per million, 1944.*

Date	Pond "A" (control)			Pond "B" (fertilized)			Reservoir		
	O_2	CO_2	MO	O_2	CO_2	MO	O_2	CO_2	MO
July 12, 1944	....	....	.....	6.65	7.5	92.5	5.35	9.0	83.0
Aug. 4, 1944	1.7	16.5	107.0	2.05	9.5	104.0	3.6	4.0	99.0
Aug. 17, 1944	4.8	3.0	114.0	3.7	5.0	101.0	3.6	11.0	97.0
Sept. 15, 1944	7.15	8.0	99.0	8.0	8.0	99.0	....	....	....

Chemical tests of the pond water revealed dissolved oxygen, free carbon dioxide, both phenolphthalein, and methyl orange alkalinity, and later the pH. The time available for this project precluded a more complete analysis although that is highly desirable. There was nothing of special significance in these observations except the low dissolved oxygen values for a period immediately after the ponds were first filled. The results of chemical tests for 1944 are presented in Table 1. The values presented are parts per million by weight of oxygen (O_2), carbon dioxide (CO_2) and methyl orange alkalinity (MO).

Observations on the ponds were discontinued for the winter on October 24. The ponds were drained and the fish removed. There were no fish in pond "A" (control) when it was drained. This mortality was probably caused by the very low oxygen values at the time the fish were planted and for a time after that. There were 55 Bluegill Sunfish in pond "B" (fertilized). These fish had grown rapidly and had an average length of 3 inches. While there was no basis for comparison with the unfertilized pond, since no fish survived in pond "A" (control), this was considered to be good growth.

The fish were weighed, measured, and returned to the ponds which had been refilled. Twenty-five Bluegill Sunfish were placed in each pond. The remaining five were preserved in formalin and retained as specimens.

The enormous numbers of dragon fly nymphs in the fertilized pond was the most conspicuous feature seen when the pond was drained.

POND OPERATION IN 1945

TABLE 2—*Chemical analysis in parts per million, 1945.*

Date	Pond "A"			Pond "B"			Reservoir		
	O_2	CO_2	MO	O_2	CO_2	MO	O_2	CO_2	MO
Mar. 15, 1945	8.2	....	....	9.5	1.5	....	....	....	....
June 21, 1945	.....	3.0	64.0	.....	3.0	68.0	....	....	....
Aug. 2, 1945	7.4	1.0	75.5	7.45	3.0	71.5	4.7	11.0	87.0
Aug. 22, 1945	8.05	0.0	81.5	8.75	2.0	84.0	7.6	5.0	83.0
Sept. 19, 1945	6.3	1.5	87.5	8.6	2.0	77.0	....	....	....
Oct. 9, 1945	8.25	1.5	78.5	8.2	1.5	81.5	6.3	4.0	71.0
Nov. 1, 1945	9.05	1.0	79.5	9.2	1.0	74.0	8.9	2.0	76.0
Nov. 20, 1945	10.6	1.0	73.5	10.15	1.0	76.0	10.4	1.5	79.0
Dec. 10, 1945	9.9	2.5	87.5	8.55	2.5	91.0	6.7	2.5	86.0

Observations on the ponds were resumed on March 15, 1945. The ponds were drained on May 4, 1945, and no fish were recovered. The mortality was probably due to "winter kill." The ponds were refilled fertilized and made ready to be restocked.

The ponds were restocked on May 25, 1945. Six adult Bluegills taken from nearby Long Lake were placed in both ponds "A" (control) and "B" (fertilized). These fish were not in spawning condition at this time. Two females of average size were killed and the ovaries examined. The ovaries contained eggs about half the diameter of ripe eggs.

The actual time of spawning was not observed. This is not surprising in view of the fact that observations were made at intervals of three weeks. Young Bluegill Sunfish were first seen on August 2, 1945. This is late for the appearance of young fish, but the season had been unusually cool. Furthermore they may have been present for several days before they were observed.

The ponds were operated on the same basis as in 1944. That is, pond "A" was the control and received no fertilizer, while pond "B" received regular applications of fertilizer at intervals of three weeks, beginning on May 4, 1945, and ending on August 23, 1945. Each application consisted of 50 pounds of 7.5-15-3.75 N-P-K-mixture. That was at the rate of 100 pounds per acre. The new N-P-K ratio was the result of greenhouse trials on water from the ponds.

The fertilized pond this year developed a heavy growth of filamentous algae in addition to a moderate amount of plankton algae. The unfertilized (control) pond again remained quite transparent and was moderately brown in color while that in pond "B" (fertilized) was a pronounced green.

The ponds were drained on September 19-20, 1945. The fish were small and difficult to remove from the vegetation. They were very numerous since no predators were present. The estimated number in each pond was between 12,000 and 13,000. This estimate is arrived at on the basis of the ratio of young Bluegills to two-year-old common Sunfish marked and placed in the pond for sampling purposes. Since this method gives only approximate results, it is not used to determine the total weight of fish in each pond. The size of young Bluegill Sunfish was quite uniform in both ponds. Those in the control pond ("A") were much smaller than those in the fertilized pond. The average length of Bluegills in pond "A" (control) on September 19, 1945 was 21/32 inch, while those in pond "B" (fertilized) were 1–9/16 inches in length. That is an average difference of 5/8 inch. Where other things are nearly equal this is a considerable difference. This difference is attributed to the increase in food resulting from the addition of fertilizer.

In addition to ponds "A" and "B", two small ponds designated as

ponds "C" and "D" were operated in 1945. These ponds had a surface area of 1,500 square feet. Pond "C" served as control and was not fertilized. Pond "D" received 5 pounds of 7.5-15-3.75 fertilizer at the same time that pond "B" was fertilized. This is at the rate of 100 pounds per acre, the same as in pond "B". The water in pond "C" was relatively transparent throughout the summer, while the water in pond "D" was a deep green color. These ponds had no fish in them. It was suspected that the ponds with fish would show relatively little difference in the insect population per square foot of bottom since the fish would forage them off. These two ponds then would serve as controls against ponds "A" and "B" which were populated with Bluegill Sunfish. The differences in insect populations can be seen in tables 3 and 4. The observations for September 1945 show pronounced differences.

INSECT PRODUCTION

In view of the fact that the fish with which we are principally concerned in this study are largely insectivorous, special attention was given to the response of the insect populations in the ponds to the addition of fertilizer. Differences in insect species and numbers present in fertilized and unfertilized ponds, both in the presence and absence of fishes, were especially noted.

The insects were counted per square foot in the open water season and per one-fourth square foot (using the Ekman dredge) when the ponds were frozen over. All samples are reported here on the basis of one square foot; that is, Ekman dredge samples were corrected to be comparable with the more numerous square foot samples.

There is little probability that any appreciable number of aquatic insects were present when the ponds were filled. The ponds were excavated from sandy soil which was overlaid with muck in the area of ponds "A" (control) and "B" (fertilized). Even after excavation there was some muck mixed with the sand in the bottom of these ponds. Ponds "C" (control) and "D" (fertilized) were sand only. It is assumed that no aquatic insects were present when the ponds were filled.

The rapidity with which very large populations of insects appeared was surprising. Particularly is this true of the dragon flies. The first samples were taken from ponds "A" (control) and "B" (fertilized) on October 24, 1944, about 3 months after the ponds were first filled. The results are shown in Table 3. The small number of fish in the fertilized pond is regarded as having inconsiderable influence on these populations. Similarly ponds "C" (control) and "D" (fertilized) were sampled for bottom fauna about 3½ months after they were first filled. Here again we find the ponds well populated with insects. In both instances there

TABLE 3—*Bottom fauna populations, mean number per square foot.*

	Oct. 24, 1944		Mar. 15, 1945		Sept. 20, 1945	
	Pond A Unfertilized	Pond B Fertilized	Pond A Unfertilized	Pond B Fertilized	Pond A Unfertilized	Pond B Fertilized
Ephemerida Nymph	.....	11.0	.....	.....	.....	0.4
Odonata Zygoptera	.....	1.5	.....	.....	0.4	.....
Anisoptera	9.5	41.5	4.0	10.4	.....	.....
Trichoptera Larvae	1.0	3.5	4.0	5.4	.....	.....
Hemiptera Corixidae	2.0	.....	.....	1.4	17.0	14.0
Notonectidae	1.5	1.0	.....	.....	.....	.....
Diptera Chironomidae	.....	31.0	5.4	20.0	.....	19.0
Coleoptera Dyticidae	0.5	.....	.....	.....	.....	.....
Mollusca	2.5	3.5	.....	0.4	0.4	0.7
Pisces	.....	.....	.....	.....	3.0	1.0
Amphibia Tadpoles	.....	.....	.....	.....	.....	2.7
Oligocheata	.....	.....	.....	1.4	.....	.....

is a distinctly greater number of insects per square foot in the ponds receiving fertilization. The difference in numbers of insects per square foot between pond "C" (control) and pond "D" (fertilized) is regarded as being the result of adding fertilizer. The differences between pond "A" (control) and pond "B" (fertilized) are also regarded as being the result of adding fertilizer. The insect populations in ponds "A" and

TABLE 4—*Bottom fauna populations, mean number per square foot, Sept. 20, 1945.*

	Sept. 20, 1945				
Fauna	Pond C Unfertilized	Pond D Fertilized	Fauna	Pond C Unfertilized	Pond D Fertilized
Ephemeridae Nymphs	.....	1.0	Diptera Chironomidae	1.0	130.0
Odonata Zygoptera	.....	2.0	Culicidae	.....	389.0
Hemiptera Corixidae	51.0	15.0	Tipulidae	.....	5.0
Nepidae	.....	5.0	Coleoptera Elmidae	.....	12.0
Neuroptera Sialidae	.....	1.0	Amphibia Tadpoles	1.0	1.0

"B" were subject to the predations of a population of fish, consequently these differences may not express the true values. The difference between the values for ponds "A" and "B" and those for ponds "C" and "D" are due to the presence of fish in ponds "A" and "B".

The writers are purposely avoiding conclusions at this time. Hypotheses may be permitted. The chief value derived from this experimentation thus far is the revelation of problems involved in the study.

The following hypotheses are advanced:

1. Fertilizer of the proper composition for the particular body of water will increase production of plankton algae, which in turn increase the insect population, and this is fish food.
2. Careful management of the population of fish making use of the increased food resulting from the use of fertilizer is fully as important as using fertilizer to increase the amount of food. The population of fish should be kept down to a number that will insure maximum growth. The optimum densities of populations are not yet apparent for the ponds described, but the principle is suggested by the small amount of data accumulated to date.
3. The fertilizer formula should be determined for each body of water, or at least for water from several different areas of the state.
4. Stocking new ponds should be delayed about 6 weeks after the pond is filled or until the vegetation is thoroughly decayed.

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SOME EFFECTS OF 2, 4-D ON RAGWEED AND CERTAIN WOODY PLANTS[1]

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IN AN EARLIER report[2] it was noted that low concentrations of 2, 4-dichlorophenoxyacetic acid could be used to inhibit pollen formation in common ragweed. This ability to stop pollen production, together with the absence of toxicity to animal life and the relatively inexpensive nature of the chemical, led to further experiments with 2, 4-D.

Recent developments in chemical weed control methods and the prospect of a considerable increase in tourist traffic have caused garden clubs, resort associations and various civic organizations to become interested in setting up a program of weed plant control in Michigan. Ragweed and poison ivy are the two weed plants of major interest to these organizations. Complete eradication of poison ivy is desired, but in many areas it is desirable to have ragweed rendered sterile, so far as pollen production is concerned, but not killed quickly. The plants have some value in preventing soil erosion and also as a cover for otherwise bare and unattractive vacant land areas.

The experiments reported here indicate that it is possible to develop a program of weed control that will serve the purpose of reducing pollen production and retain plant growth during the summer and fall.

Ragweed

During the summer of 1945 several formulations of 2, 4-D at various concentrations were applied on plots, each one square rod in area, of a thick stand of ragweed growing on a muck soil. Spray applications were made on ragweed plants in stages of growth that ranged from young plants to mature, pollinating specimens. 2, 4-D is frequently slow in action and certain other chemicals were added to the spray solutions to serve as activators in speeding up the action on old ragweed. The materials and concentrations used are shown in Table 1.[3] All spray

[1]This is a report of work which was done as a joint project of the Section of Botany, Michigan Agricultural Experiment Station, and the Michigan Department of Health Laboratories.

[2]Grigsby, B. H. Inhibition of Pollen Production in Ragweed by the Use of Chemical Sprays. Mich. Agr. Exp. Sta. Quar. Bul. *28*: 45-48, 1945.

[3]The various formulations of 2, 4-D were supplied by the Dow Chemical Co., the duPont Co., H. C. Thompson Co., and the American Chemical Paint Co.

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Table 1—*Formulations and concentrations of chemicals applied to ragweed.*

Formulation	Concentrations parts per million		
Sodium salt of 2, 4-D	1000	500	250
Sodium salt + Ammate		500	250
Sodium salt + sodium chlorate		500	250
Ammonium salt of 2, 4-D	1000	500	250
Ammonium salt + Ammate		500	250
Weedicide, liquid	1000	500	250
Weedicide, tablets	1000	500	250
Weedone, liquid	1000	500	250

solutions were applied at the rate of 150 gallons per acre to insure adequate coverage of the leaf surface.

Woody Plants

Poison ivy was sprayed at East Lansing and on Mackinac Island with 100 p.p.m. 2, 4-D in early summer and late fall.

In another series of experiments, solutions of 2, 4-D, ammate and sodium chlorate were applied to poison ivy, poison sumac, willow, dogwood, Tartarian honeysuckle, meadow-sweet, raspberry, elm, elderberry and alder. These woody shrubs were sprayed in July and August and were not in an active stage of growth.

RESULTS

When equivalent concentrations of 2, 4-D alone were compared, no significant differences were noted in the action of the various formulations of 2, 4-D on ragweed plants. High concentrations of all forms killed ragweed in a period of 8-14 days. Hamner and Tukey[4] have reported ragweed killing in 11-29 days. The effects of lower concentrations depended upon the stage of growth at which spraying was done.

A concentration of 1,000 p.p.m. killed young plants quickly, but 10-14 days were required to kill mature, pollinating plants. However, in old plants pollen release was not evident 2 days after the spray application and did not occur again in the sprayed plants.

A concentration of 500 p.p.m. was equally effective in killing young ragweed. However, when this concentration was applied to plants which were just beginning to shed pollen further development of male flower spikes was stopped. Lateral branches from the sprayed plants failed to produce any flower stalks and such plants were thus rendered sterile so far as pollen formation was concerned.

[4]Hamner, C. L. and Tukey, H. B. Selective Herbicidal Action of Midsummer and Fall Applications of 2, 4-Dichlorophenoxyacetic Acid. Bot. Gaz. *106:* 232-245, 1944.

Fig. 1. The effects of 2, 4-D upon ragweed. Top, unsprayed. Center, 250 p.p.m. sprayed before flower spikes were formed. Bottom, 500 p.p.m. Note curvature of stems of sprayed plants.

Concentrations of 250 p.p.m. applied to young plants stopped the growth in height of these plants and prevented flower spike development. The leaves remained green and rosette-like clusters of leaves were formed at the tips of the branches. Curvature, twisting and cracking of stems was frequently observed in the sprayed plants. Such plants remained alive until frost but did not produce any pollen. Some of these effects are shown in Fig. 1.

Plants sprayed with 250 p.p.m., after pollen shedding had begun, responded to the chemical by developing a sharp curvature of the flower-spike axis so that the spikes turned downward but pollen formation continued and new flower spikes developed from axillary buds.

One of the duPont products used in these experiments contained a considerable amount of ammate and was found to kill ragweed quickly. This quick action is not always a desirable quality in the control of ragweed pollen, however, and a series of spray applications of 2, 4-D mixed with small quantities of ammate and sodium chlorate was made.

The addition of 15 grams of ammate or sodium chlorate per gallon of spray solution to a 250 p.p.m. concentration of 2, 4-D very markedly increased the toxic action of the concentration. These mixtures applied to young ragweed caused the death of sprayed plants within 5 days. When applied to pollinating plants the flower spikes were turned downward in 24 hours and pollen release was stopped. All leaves and flower parts soon developed a straw-yellow color and no further growth was observed.

Concentrations of 20 and 30 grams of either chlorate or ammate produced a very rapid killing of ragweed at the 250 p.p.m. level of 2, 4-D; 1,000 and 500 p.p.m. 2, 4-D with 5 or 10 grams of ammate or chlorate caused the death of old ragweed plants within 5-8 days and stopped pollen production within 48 hours.

Ammate, at the rate of ¾ pound per gallon, was found to be an effective killing agent on poison ivy, poison sumac, willow, raspberry and most other woody shrubs. Applications of this material made on July 27 killed the leaves of all these plants in 4 days and prevented the formation of new leaves for the rest of the season. Examination at the time of the first killing frost revealed that the above-ground parts of all sprayed plants were dead. The plants were left for observation in the spring to determine whether sprouting from underground parts would occur.

Applications of 2, 4-D were made at several different times during the growing season, beginning in May and extending through September 15. A concentration of 1,000 p.p.m. was used and several formulations of 2, 4-D were tried. Results from these experiments are some-

what inconsistent. Sprayings done in May generally killed the leaves and young stems of poison ivy but the lower portions of the stem frequently remained alive. However, regrowth was not observed in any of these plants.

Spraying done in July and August usually produced the same results as the earlier applications, but one patch of ivy growing under some large elm trees gave no indication of having been sprayed. A repeat application on this area early in September produced a brilliant color change in the leaves and all the leaves dropped two weeks after the spraying. These plants are to be observed in the spring to determine the degree of killing obtained.

Poison ivy along several miles of roadway on Mackinac Island was sprayed in early September. Rapid color change in the leaves, similar to that induced by cold weather and early leaf drop was observed. The full effect of this late application cannot be determined until growth is resumed in the spring.

Several large clumps of poison sumac were sprayed with 1,000 p.p.m. of 2, 4-D in July. No visible effect upon this plant was observed. Other clumps sprayed in August underwent a color change similar to that in poison ivy, but the leaves did not fall until frost defoliated all woody shrubs.

An ammate-2, 4-D mixture was no more effective on poison sumac than ammate alone.

No response to 2, 4-D, 1,000 p.p.m., was observed on dogwood, raspberry, alder, honeysuckle and meadow-sweet. A marked twisting of leaf petioles and young stems was observed in elderberry but the sprayed plants were not killed. Similar results were observed on bittersweet nightshade.

DISCUSSION

The results reported here on the effects of 2, 4-D support the view that it is possible to control the amount of pollen produced by ragweed plants without the complete destruction of these plants. Many areas in Michigan are covered, during the summer and fall, with a heavy growth of this plant and produce large amounts of pollen which is airborne and causes hay fever in 5 to 10 percent of the population. Thus ragweed is a menace to the comfort and health of a large number of people. However, the ragweed-infested areas usually are fallow lands, roadsides, and other uncultivated areas where a cover of vegetation is needed to prevent soil erosion. A program of weed control which would reduce the pollen production in these areas yet retain the soil-holding properties of the native vegetation seems desirable.

2, 4-D can be used to develop such a program and at a reasonable cost. Spraying at a time when ragweed is approaching flower production, with a concentration of 250 p.p.m., can be done at a cost of less than $1 per acre for chemicals. When power spray equipment can be used the total cost for materials and labor will not exceed $1.50 per acre. Hand spraying will be somewhat more expensive but is possible on small areas of ragweed. Thus a practical pollen-inhibiting program can be conducted on a scale that may alter the usually high pollen concentration in the air during August and September.

Early applications are to be preferred, but by increasing the concentration of 2, 4-D to 500 p.p.m., or by the addition of ammate or sodium chlorate to the spray solution it is possible to stop pollen release after the ragweed plants have begun to flower. Such treatments will be more expensive but the beneficial results may, in some cases, justify the additional cost.

The widespread use of spraying for the control of ragweed pollen could have other valuable results. While the concentrations of 2, 4-D recommended for this purpose do not kill ragweed outright, they will contribute to the gradual eradication of the plant. Very few seeds are produced by sprayed plants and if this treatment were continued for some years a slow exhaustion of the present large supply of seeds in the soil would occur. Soil erosion, however, would not be increased because grasses and many other plants would not be eradicated by the spray treatment. Grain stubble, and even growing corn can be sprayed with the low concentration without apparent injury. Eradication of ragweed, in sprayed areas, appears to be possible but will require several years of spraying operations.

Control of poison ivy by the use of ammate is possible. However, the high cost of this chemical somewhat limits the usefulness on large areas. Many Michigan roadsides, state parks and other recreational areas have a heavy infestation of this plant and a control program is needed. The use of 2, 4-D on ivy, while not producing results as quickly as ammate, is recommended. It seems now that more than one application and probably a cencentration greater than 1,000 p.p.m. will be required for eradication of ivy but it is possible to destroy the aboveground parts of the plant with 2, 4-D. This alone would avoid many cases of ivy poisoning in children and adults who are not familiar with the appearance of the ivy plant.

Poison sumac, while not of great importance because it is found only in swampy areas, causes a number of cases of poisoning each season. Control of this plant can be secured by spraying with ammate. 2, 4-D does not seem to give satisfactory control of poison sumac, nor of most other woody shrubs.

SUMMARY

Ragweed can be killed by a single application of 2, 4-D at a concentration of 1,000 p.p.m.

Pollen production by old plants can be stopped, without causing the immediate death of the plants, by spraying with a concentration of 500 p.p.m. A more rapid response can be obtained by the addition of very small amounts of either sodium chlorate or ammate.

Pollen formation can be prevented by spraying ragweed in the stage of growth just preceding flower-stalk elongation with 250 p.p.m. 2, 4-D. Plants sprayed in this stage appear to be arrested in development and usually persist until frost. Few seeds are produced by such plants.

The young growth of poison ivy is usually killed by 100 p.p.m. of 2, 4-D but older growth may be somewhat resistant. Eradication of ivy by this method has not been demonstrated.

2, 4-D seems to have but little effect upon mature growth of many woody plants.

DETECTION OF RAW MILK CONTAMINATION IN HOMOGENIZED MILK BY MEANS OF THE PHOSPHATASE TEST AND BY ORGANOLEPTIC EXAMINATION

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Dorner and Widmer (1) showed that rancidity always developed in raw homogenized milk and in pasteurized homogenized milk to which raw milk had been added. They emphasized that homogenized milk must be a pasteurized product. These findings have been verified since by many workers. Practical experience has demonstrated that raw milk has no place in the homogenized milk field, or vice versa.

Since homogenized milk must be pasteurized, it has a public health significance. Some instances in commercial operation have demonstrated that if raw milk contamination of homogenized milk occurred, the rancid flavor developed would be so repulsive within 24 hours that people would not consume it. Thus, the taste of the milk would seem to be a good criterion by which contamination of homogenized milk with raw milk might be judged. On the other hand, public health control officials rely on the phosphatase test to determine if milk has been adequately pasteurized, and whether it has been contaminated with raw milk.

In view of these two means of detecting contamination of homogenized milk with raw milk, it seemed advisable to compare the effectiveness of the phosphatase test to the organoleptic test on milks in which there were various levels of raw milk contamination. To this end five trials were run. The data obtained on a representative trial are presented in tables 1, 2, and 3. The milk used was of high quality, pasteurized at 143° F. for 30 minutes and homogenized at 2,500 pounds pressure, after which it was cooled and bottled. The milk contained approximately 3.9 percent fat. The raw milk used for the contaminant was mixed milk of good quality. Tests were made according to standard procedures. All organoleptic examinations were made without the identity of the samples being known to those examining the samples.

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RESULTS

Effects of raw milk contamination of homogenized milk on the phosphatase test and on the development of rancidity

The intensity of rancidity developed when homogenized milk was contaminated with raw milk depended upon the percentage of contamination (Table 1). Rancidity developed in homogenized milk when as little as 0.5 percent of raw milk was added to the pasteurized product, after 7 days at 40° F. Rancidity was not encountered in the contaminated homogenized milk when 0.05 or 0.1 percent raw milk was added and the mixtures similarly stored. From the trend of the data obtained, it would seem that rancidity should eventually occur in milk to which 0.05 percent or 0.1 percent raw milk was added. It is unlikely, however, that homogenized milk intended for fluid consumption will be stored longer than 7 days even in the home. If rancidity, induced by raw milk contamination, is encountered in homogenized milk at 24 hours, the contamination must have exceeded 2 percent. In three of the five trials, rancidity was noted questionably at 24 hours at the 2-percent contamination level. On the other hand, rancidity was identified positively in only one of the five trials at the 4-percent contamination level. Thus, it seems that 4 percent or more raw milk contamina-

TABLE 1—*The detection of various percentages of raw milk added to homogenized milk as determined by organoleptic examination.*

Addition of raw milk (%)	Intensity of rancidity at				
	0 hrs.	1 day	2 days	4 days	7 days
NOT HOMOGENIZED					
0.00	−	−	−	−	−
0.05	−	−	−	−	−
0.1	−	−	−	−	−
0.5	−	−	−	−	−
1.0	−	−	−	−	−
2.0	−	−	−	−	−
4.0	−	−	−	−	−
8.0	−	−	−	−	?
10.0	−	−	?	?	?
HOMOGENIZED					
0.00	−	−	−	−	−
0.05	−	−	−	−	−
0.1	−	−	−	−	−
0.5	−	−	−	?	+
1.0	−	−	?	+	+
2.0	−	−*	+	+	+
4.0	−	−*	+	+	+
8.0	−	+	+	+	+
10.0	−	+	+	+	+

*Rancidity was noted questionably in three of the five trials at these levels of contamination.

tion must be present before rancidity can be recognized in homogenized milk after 24 hours.

During these same 7-day storage periods, the titratable acidity of the contaminated homogenized milk increased from 0.16 percent to approximately 0.21 percent (Table 2). Little increase in titratable acidity was noted when the increments of raw milk added were 0.05 percent or 0.1 percent. Generally a 0.01-percent increase in titratable acidity would be detected by organoleptic examination. The pH of the mixture decreased in 7 days from 6.65 to 6.5.

At the levels of raw milk contamination used, questionable positive phosphatase readings were noted in three of the five trials when 0.1-percent raw milk was added to the milk. Positive readings were not noted in the fresh mixture when 0.05-percent raw milk was added. However, in two of the five trials positive readings were obtained on the raw milk-homogenized milk mixture, when 0.05-percent raw milk was added and the mixture held 7 days. This observation would seem to be in accord with Leahy and Associates (2) who state that certain organisms produce phosphatase in quantities sufficient to detect when they occur in numbers over 2,000,000 per cubic centimeter (plate count). However, bacteria counts were not made on the samples to verify these numbers.

TABLE 2—*The change in titratable acidity and pH during storage when various percentages of raw milk were added to homogenized milk.*

Addition of raw milk (percent)	Titratable acidity and pH at									
	0 hrs.		1 day		2 days		4 days		7 days	
	Acidity (percent)	pH	Acidity (percent)	pH	Acidity (percent)	pH	Acidity (percent)	pH	Acidity (percent)	pH
NOT HOMOGENIZED										
0.00	0.16	6.6	0.16	6.6	0.16	6.6	0.16	6.6	0.16	6.6
0.05	0.16	6.6	0.16	6.6	0.16	6.6	0.16	6.6	0.16	6.6
0.1	0.16	6.6	0.16	6.6	0.16	6.6	0.16	6.6	0.16	6.6
0.5	0.16	6.6	0.16	6.6	0.16	6.6	0.16	6.5	0.16	6.6
1.0	0.16	6.6	0.16	6.6	0.16	6.5	0.16	6.5	0.16	6.6
2.0	0.16	6.6	0.16	6.6	0.16	6.5	0.16	6.5	0.16	6.6
4.0	0.16	6.6	0.16	6.6	0.16	6.5	0.16	6.5	0.16	6.5
8.0	0.16	6.6	0.16	6.6	0.16	6.5	0.16	6.5	0.16	6.5
10.0	0.16	6.6	0.16	6.6	0.16	6.5	0.16	6.5	0.16	6.5
HOMOGENIZED										
0.00	0.16	6.6	0.16	6.6	0.16	6.6	0.16	6.6	0.16	6.6
0.05	0.16	6.6	0.16	6.6	0.16	6.6	0.16	6.6	0.16	6.6
0.1	0.16	6.6	0.16	6.6	0.16	6.6	0.16	6.6	0.17	6.6
0.5	0.16	6.6	0.16	6.6	0.16	6.6	0.17	6.6	0.17	6.6
1.0	0.16	6.6	0.16	6.6	0.16	6.6	0.17	6.5	0.17	6.5
2.0	0.16	6.6	0.16	6.5	0.17	6.5	0.17	6.5	0.18	6.5
4.0	0.16	6.6	0.17	6.5	0.17	6.5	0.18	6.5	0.19	6.5
8.0	0.16	6.6	0.17	6.5	0.18	6.5	0.19	6.5	0.20	6.5
10.0	0.16	6.6	0.17	6.5	0.18	6.5	0.19	6.5	0.21	6.5

These data indicate that the phosphatase test is a far more reliable test in the detection of raw milk in homogenized milk than is the organoleptic examination for rancidity.

Effects of raw milk contamination of non-homogenized milk on the phosphatase test and on the development of rancidity

When the same milk not homogenized, but pasteurized, was contaminated with similar increments of raw milk, not even slight rancidity occurred except when relatively large percentages of raw milk were added and the mixtures held from 4 to 7 days. Likewise, the titratable acidity increase was very small and appeared to be within the limits of experimental error. However, slight decreases in pH were noted. On the other hand, the phosphatase tests showed readings identical to those obtained with homogenized samples containing the same corresponding percentages of raw milk.

Observations on phosphatase tests as applied to homogenized milk

Perry and Doan (3) reported no differences in results when phosphatase tests were made on the same milk, homogenized and non-homogenized. The results here confirm this, referring only to the intensity of blue in the alcohol extractions. There was a distinct difference, however, in the color of the tests of the homogenized and non-homogenized samples after the addition of the indicator, but before the alcohol extraction. It seems advisable to point out this difference in color, owing to the practice sometimes followed, of eliminating the extraction when it appears to be unnecessary. The milk-buffer substrate-B.Q.C. mixture was always darker in the non-homogenized than in the homogenized tests. This could easily lead to confusion, particularly when both homogenized and non-homogenized milks are tested in the same series. This suggests that the alcohol extraction must be mandatory and not optional. The color difference is obviously not one of phenol content, as is proven by comparing the extractions. It is owing no doubt to the physical change caused by homogenization.

When making the phosphatase test on homogenized milk it is important to mix the reagents very gently; otherwise a jell forms in the alcohol layer and reading is difficult. Rather vigorous mixing of the non-homogenized samples did not produce a jell. Repeated mixing at 5-minute intervals over a period of 20 minutes did not result in deeper colored alcohol layers in the non-homogenized tests. In testing either kind of milk, the alcohol extraction is complete after two or three gentle inversions of the tubes.

TABLE 3—*The detection of various percentages of raw milk added to homogenized milk as determined by the phosphatase test.*

Addition of raw milk (percent)	Phosphatase reading* at				
	0 hrs.	1 day	2 days	4 days	7 days
NOT HOMOGENIZED					
0.00	−	−	−	−	−
0.05	−	−	−	−	−
0.1	−**	−**	−**	±	±
0.5	+	+	+	+	+
1.0	+	+	+	+	+
2.0	+	+	+	+	+
4.0	+	+	+	+	+
8.0	+	+	+	+	+
10.0	+	+	+	+	+
HOMOGENIZED					
0.00	−	−	−	−	−
0.05	−	−	−	−	−
0.1	−**	−**	−**	±	±
0.5	+	+	+	+	+
1.0	+	+	+	+	+
2.0	+	+	+	+	+
4.0	+	+	+	+	+
8.0	+	+	+	+	+
10.0	+	+	+	+	+

*Key: −, negative test; +, positive test; ±, less than 2 Sharer blue units.
**Questionably positive tests in three of the five trials.

SUMMARY

Observations with respect to development of rancidity, titratable acidity, pH and phosphatase tests were made on five series of homogenized and non-homogenized milk to which various increments or raw milk had been added. During storage at 40° F. raw milk-contaminated homogenized milk increased in titratable acidity, decreased in pH and developed rancidity. The contamination could be detected positively by the phosphatase test when 0.5-percent raw milk was added, questionably when 0.1-percent was added but not when 0.05-percent was added. The level of contamination detectable by organoleptic examination depended largely upon the length of the storage period. In general, at 24 hours' storage, contamination of homogenized milk with raw milk must be at least 4 percent before rancidity can be detected by taste and smell. In no case could organoleptic examination detect the addition of 0.1-percent raw milk when mixtures were held 7 days at 40° F. Extracting the phenol with butyl alcohol should be a required step and not optional in the phosphatase test, particularly when applied to homogenized milk.

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A STUDY OF MOISTURE ABSORPTION OF HAY WHEN EXPOSED TO ATMOSPHERES WITH VARIOUS MOISTURE CONTENT

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One of the main problems in the use of mow driers is that of their operation in cold or wet weather. In bright sunny weather, the air is usually relatively dry—that is, has a low relative humidity and will rapidly evaporate water from the hay. To the contrary, in wet, rainy, or foggy weather, the relative humidity is high—from 75 to 95 percent relative humidity—and the air has little ability to take up more moisture by evaporation. The question has arisen in many cases, "Does blowing this rather damp and perhaps cool air through the hay do more damage than good? Does the hay take up moisture from the air, and become wetter, rather than drier? How long can such weather last before the hay will become very hot, or moldy, and how much good does blowing air through the hay accomplish?" Many other questions along these lines might be asked.

In previous experiments, experiment station workers have discovered that the moisture content of wheat, flour, and mixed feeds, as well as many other common substances, is affected by the relative humidity of the atmosphere with which they are in contact. When moved from dry to damp air, these substances will gradually take up and hold additional water, even to the extent of molding badly. In a very damp atmosphere, molding may start within a few days, while for longer storage, over a period of months, the relative humidity should not be much above 70 percent.

In Michigan during hay-curing season, United States Weather Bureau records show that the relative humidity frequently reaches 80 percent at night, and sometimes may go to 90 percent for a few hours. On a good haying day, the relative humidity is likely to be below 50 percent. On cool days, the relative humidity is usually higher than on warm days. In order to determine the effect of various atmospheric moisture conditions on the moisture absorption of hay, a series of experiments were made as follows:

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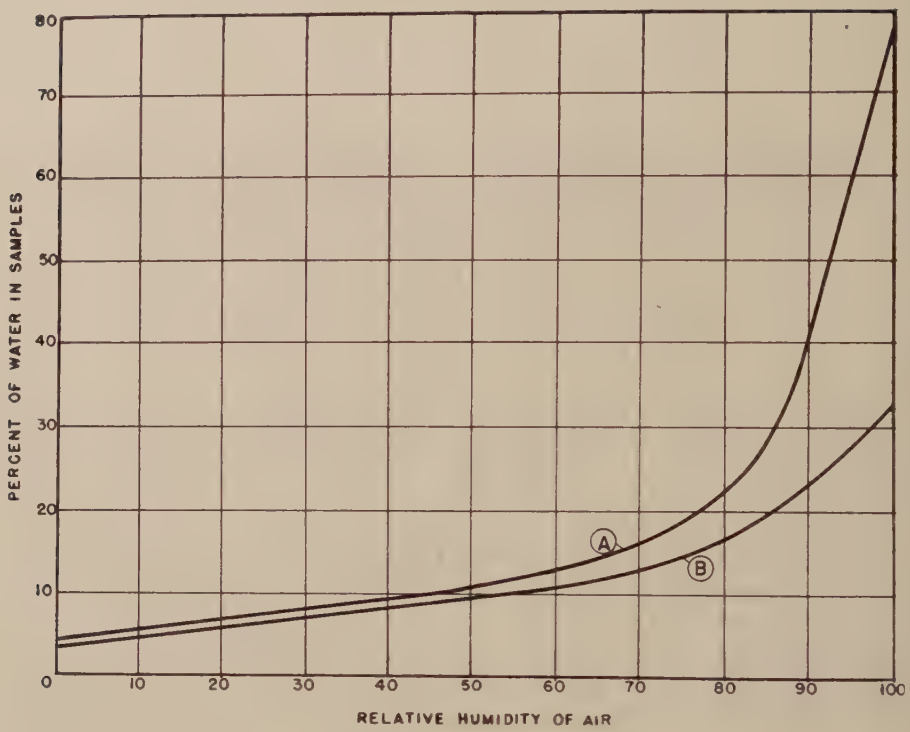

EXPERIMENTAL

To obtain atmospheres of selected relative humidities, tightly covered glass containers were partly filled with solutions of sulphuric acid which previous experiments have shown to maintain constant relative humidities, depending upon the strength of the solution. In these jars, the samples of hay were suspended. The samples were weighed upon several occasions over a period of one to four weeks until the hay neither lost nor gained weight.

Description of Samples

A. Two sets of samples of freshly harvested alfalfa hay were exposed in the jars without previous drying.

B. Four samples of alfalfa hay, barn dried for several months were used.

RESULTS

The table shows the percentage of moisture that the various lots of hay attained in equilibrium with the atmosphere of various relative humidities. The curves give these data in graphic form. The barn-dried samples reached equilibrium within about 10 days. At this time the lots

Table 1—*Average moisture content of hay samples after being exposed to air with various relative humidities.*

	Relative humidity	0	20	40	60	70	80	85	90	100
A.	Freshly harvested samples	5	7	9	13	16	23	30	40	79
B.	Barn-dried samples	4	6	8	11	13	16	20	24	33

stored at 100 percent relative humidity were badly molded, and the samples at 90 percent were musty. There was little or no evidence of molding at 85 percent. The fresh samples maintained their green and fresh condition for a week or more at relative humidities of 90 and 100 percent, but finally became a mass of mold. At 85 percent relative humidity, the fresh samples molded considerably, and were musty at 80 percent.

DISCUSSION

From these results, we can conclude that hay that is almost dry enough to keep in the mow is incapable of taking up moisture from the air unless the relative humidity is 85 percent or more. Such hay would not be injured, or greatly affected by the operation of the blower during a shower. Curve A, for partly cured hay, indicates that air at 85 percent relative humidity would have a drying effect—slight, it is true—on any hay containing more than 30 percent moisture. In addition to its drying effect, it would keep the hay cool and thus tend to slow down the formation of molds. Maintaining the uncured samples in an atmosphere of 80 percent relative humidity caused such slow drying that molds developed, even though the samples finally dried to about 23 percent moisture.

SUMMARY AND CONCLUSIONS

From the results of these experiments, the conclusion may be drawn that the relative humidity of the atmosphere need not be known with any great degree of accuracy in order to operate a mow-drier effectively. When the humidity is greater than 85 percent—which is common only during actual rain or fog—little water is evaporated from damp hay, and the function of the blower is largely to keep the hay from heating. Operation of the blower at night, when humidities are relatively high, seems to offer little possibility of depositing moisture in partly cured hay. If water is absorbed from the damp air, it will be only at the bottom of the mow, by hay that is already dry enough to keep. This partially dried air would then be capable of evaporating water from the upper, damper layers of hay. Until the top layer of the hay has dried, the only time that it seems advisable to turn off the fan is during fog or heavy rainfall.

FARMER CO-OPERATION TO MEET EMERGENCY LABOR NEEDS DURING THE WAR YEARS

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THE PROBLEM—1943

THE DEMANDS FOR labor to maintain the high level of food production for war requirements had, by early 1943, exceeded the visible supply of both year-round and seasonal workers in many parts of the country. Through the organization of an emergency farm labor program it was hoped that full utilization would be made of all available labor and the requirements satisfied. This program was centered in the office of the county agricultural agent and was designed to regulate the use and flow of the seasonal labor supply, to recruit local workers in urban and rural areas, and in other ways to meet the demands for agricultural production and food processing as they arose. Differing local conditions, the attitudes of different county agricultural agents and the efforts of local farmers all produced widely differing plans to meet the same problem. It is our purpose to describe the methods used in Shiawassee County, Michigan.

The problem in this county was dependent upon the pattern of farming. Most of the farmers were engaged in the production of feed crops for milk production. There were a few, however, who devoted all or a part of their time and land to the production of cash crops. The principal cash crops included sugar beets, dry beans, sweet corn, peas, and cucumbers. These crops needed additional amounts of labor during the harvest season. Most of this production (with the exception of the sugar beets) was contracted for by a local canning company which also needed extra amount of labor during the harvest season.

In the past, unskilled agricultural labor had been supplied by migrant Mexicans who worked in sugar beets and were available for some other harvesting operations, by a few other migrant workers, and by a local surplus of labor found both in the towns and rural areas. The canning

*The author wishes to express his appreciation to Mr. C. V. Ballard of the Extension Service who introduced him to Mr. E. R. Hancock of Shiawassee County and the opportunity to learn of methods used to meet farm labor problems during the war. The author is indebted for the many hours which Mr. Hancock gave to answering questions about a past event and for arranging opportunity to talk with some of the people who also worked on this problem.

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company needs were met largely by young men and women, drawn from town and country, who worked for a period of several weeks during the peak of the season.

By 1943, this seasonal supply of labor had either disappeared or had become very uncertain. The surplus female labor used in the canning factory had been drawn into expanded war industries within the same locality and elsewhere. The urban males had either found jobs in war industries or had been drafted into the army. Local farm labor on which both farmers and the canning company depended, had also been depleted by the draft and by employment in war industries.

The agricultural labor problem for Shiawassee County was simple in its outline. The local labor source on which dependence was formerly placed did not exist and migratory labor was uncertain. The needs of the farmers had become more critical through the loss of numbers of young men to the army. The canning company had no visible supply of labor unless it could be found locally.

It is the purpose of this paper to describe the plan which was developed to meet these needs, how it was organized and how it operated.

THE PLAN OF CAMPAIGN

The key to the success of the formation of a volunteer labor group to meet emergency needs rested in the factors of approach and organization. The county agricultural agent took the first step by calling a meeting of draft-age farm boys, their fathers and a few others at the court house in Corunna in the spring of 1943. The needs for agricultural labor were listed, together with a plan to meet these needs, and the results that might be expected to follow from the working of this plan. Agreement and support to the proposal was secured and the decision reached to go ahead with the plan.

Township meetings in 14 localities were called by the county agent. Previous to each meeting he addressed a personal letter to a majority of the farmers of that township, announcing the time and place and purpose. In only one instance did attendance fall below 60, which meant that 80 to 85 percent of those to whom letters had been addressed were in attendance. Those invited to the meetings included the heads of families with sons of draft age, draft-age farmers, and key men in the township.

The pattern of each meeting was substantially the same. The county agent outlined the agricultural labor needs of the county for the coming year. The needs were detailed not only in terms of farm labor but of workers for the processing plant and for other industries connected with agricultural operations. The sources of labor supply

were then inventoried, with the conclusion that if the county was to meet its needs workers would have to come from within the county. It was pointed out that the local labor surplus had already been absorbed and migratory seasonal labor was a highly uncertain element. The point was also made that it would be necessary to depend upon the young men of draft age to meet these needs, and unless it was possible to show that these men were engaged in essential agricultural operations, they would be subject to immediate draft call. It was emphasized that the people of each township would have to meet most of their own needs as well as be ready to assist in emergencies in other localities or in the packing plant in town.

The presentation was designed to indicate the problem that the farmers faced; that it was a problem which could be solved only by themselves and through cooperation among themselves; and to indicate a course of action to meet the needs and solve the problem.

The organization of the labor group for emergency work entailed the election or appointment of a township chairman who was also called a labor dispatcher. This was accomplished at the first meeting. The individual filling this role needed certain qualifications. He ought to be centrally located in the township with a phone, a full understanding of the needs and how they could be met, and a willingness to devote extra time. Preferably he should be the father of a deferred boy.

The next step was an inventory of the needs and potentials of the township. This was accomplished through a house-to-house canvass, made in most instances by boys of draft age. They determined for each farmer his crops and acreages, how much additional help he would need and when, and how many days he and his sons would have free to assist other farmers.

The key to the functioning of the whole system was the county agent. He was in actual or potential contact with the labor dispatcher of each township. He knew or could easily learn the actual needs of most farmers and the amount of available labor for emergencies. He was the point of contact through which demands for labor that could not be met within the township would flow. Request for labor from the canning factory or the pickle company, were relayed through his office. Requests from other industrial activities which needed an immediate labor supply, such as the local elevator, lumber yards, and individual farmers also came to him.

An examination of some specific situations will illustrate how the system was organized. A local farmer would need, let's say, three men for five days to assist in his bean harvest. He would call the labor chairman of his township and make known his wants. The labor chair-

man would then recruit the necessary labor from his list. It might develop that one of the men contacted was able to give only two days, so that then it would be necessary to find someone else to supply three days. Through the local chairman the township was able to meet most of its local needs.

It was not always possible to find sufficient labor within the township to meet the needs of those farmers who were producers of speciality cash crops or had large acreages. In such instances the township chairman, or the farmer in need, would get in touch with the county agent. The latter would then call the chairman of neighboring townships until the needed number of men was found.

The method of meeting the needs of the canning factory was substantially the same. A representative of this concern informed the county agent of the labor needs and the period of time that employment could be expected. These labor requirements were of course much larger than for individual farm operations and it was necessary for the county agent to contact several chairmen before the quota was filled. The county agent was in the position of knowing the approximate labor resources of each township, and was able to make an equitable apportionment. In one instance the call came for 25 workers and within an hour and a half 22 men were on the job.

The majority of the workers enlisted under this plan were draft-age farm boys, although in several cases their fathers, or farmers without sons also cooperated when the need arose. Most of the work was paid for on an hourly basis, but there were instances reported where an exchange of labor was worked out between farmers and in some instances young men gave one or two days' work and refused pay when it was offered.

Young farmers were not the only ones who were organized in the emergency farm labor program. Women were encouraged to volunteer their services through a "women's land army," but this was not too successful because those who were not regularly employed were in most instances housewives.

In one locality, cooperative efforts extended to the pooling of machinery and the sharing of labor between groups of farmers. The farmers worked out a plan by which they worked on different farms in rotation. By this system they were able to concentrate labor and machinery as the land or crop of each farmer was ready for planting or harvesting. It was reported that in one instance six farmers were working together planting oats in one man's field. Presumably the cooperating group moved from farm to farm until planting operations were completed. Silo filling and harvesting called forth additional cooperation. High

school students who held marks of a set standard were also occasionally released from classes to work in factory or farm. The canning factory management also worked out arrangements with some of the local factories so that a certain number of men might be released early with the understanding that they would work in the canning factory. Some Mexican and other migratory workers also came into the county and were utilized by those farmers who were able to secure their help.

THE SITUATION 1944-45

During the years 1944 and 1945 the township organization for the provision of emergency labor needs was not utilized. The availability of large numbers of prisoners of war made it no longer necessary to depend upon local volunteers. All of the requirements of the canning company were met from this source as were the needs of many farmers who needed larger numbers of workers extending over a several day period.

This new supply of labor did not solve the labor needs of the independent farmer who depended heavily upon the assistance of a grown son and who could find no steady help if his son were drafted, nor of the farmer whose son had been called into the army and was without regular assistance.

The county agent met this problem by a slightly different plan of organization and with the cooperation of the local draft board. The first step was the computation of the number of man day's labor requirements needed for farm operations on each draft-deferred boy's farm, or his father's farm. Where this total was less than the number of days needed for deferment, the boy agreed to work an additional number of days on other farms in order to make up the deficiency.

A record system was established in the county agent's office. On each card was listed the number of days work required for his own or father's farm and the days to be worked elsewhere. As labor needs arose, farmers would call the county agent asking for so many days of work. The agent would then make contact with boys who had a deficiency to meet and tell them to go to such and such a farm. Each boy was given a sheet on which was recorded the number of days contributed to other farmers and a similar record was kept in the county agent's office. Through this system the county agent was able at any time to call upon the individuals who had not met their minimum requirements.

Centralization of direction in the agent's office was necessary because of the need to make certain the requirements of the Selective Service board were being met. The full responsibility rested with the

agent who held the authority to bring needed pressure to gain compliance. There were a few cases in which deferred persons did not cooperate. In such instances the county agent after an appropriate investigation, warned the young man and his father that future noncooperativeness would mean draft board action. Such warning was usually sufficient.

WHAT ABOUT 1946?

The uncertainties of the 1946 agricultural season are as great as those of the preceding years. The prisoners of war are gone. A good many of the young men in the army will be back, but whether they will be on the farms is another question. The slack of industrial employment that might provide seasonal workers for the canning factory has not appeared.

Farmers report that they are unable to secure the kind of permanent hired help for which they are looking. As one man put it, "It used to be that you could get a man who had an interest in your interest. Now they just work for you." There are no longer the incentives, patriotic or otherwise, that will stimulate men to assist one another in their seasonal load. Reports indicate that farmers are putting more money into equipment that will eliminate the need for calling on one's neighbors or employing seasonal workers. The feeling was expressed that "one doesn't want to feel obligated to his neighbors."

With the incentives for sharing with one's neighbors greatly lessened, owing to the end of the war, and with the removal of the threat of draft board action as an impelling motive for fathers to permit their sons to work elsewhere, it seems unlikely that the solution to labor needs is going to be found within the community.

It is more probable that the trends of recent years will be accentuated. Farms will be consolidated and labor needs will be met through additional machinery. Young men wanting to go into farming will have to seek the status of either tenant farmer, or more likely that of hired man on some of the larger units. Crops which demand seasonal labor but for which there is an uncertain, untractable, or high priced supply will be discontinued in favor of those that can be produced without these disadvantages.

The only possibility for a checking of reversal of this trend will come if the many independent farmers band together to form cooperative machinery and labor sharing groups that meet their respective needs collectively. That both of these are possible of achievement was demonstrated during the war years.

THE RESIDUAL EFFECT OF CROP ROTATIONS ON POTATO YIELD AND THE PRESENCE OF POTATO SCAB

*By E. J. WHEELER**
SECTION OF FARM CROPS

THE CONTROL OF potato scab *(Actinomyces scabies)* has confronted potato growers for a long time. Successive cropping, with potatoes in the rotation every four years has not held the disease in check. Seed treatment with mercury or formaldehyde compounds generally has not given satisfactory results. The growing of such scab-susceptible white-skinned varieties as the Katahdin and Chippewa, where the slightly scab-resistant Russet Rural variety was grown previously, has made the scab problem more acute. Probably the best method of controlling scab is the growing of highly scab-resistant varieties. However, the supply of seed from such varieties is limited, and none of the scab-resistant varieties has been grown long enough to determine its ability to replace some of the better quality commercial varieties now extensively grown.

Potato scab is borne on the potato tuber and also lives on the organic matter of the soil. It is usually most severe in soils of medium or high pH and generally is not of serious consequence in soils having a pH of 5.2 or lower. Scab has been reported remaining in the soil for 20 years or more, even in soils where potatoes have not been grown. The nature of the scab organism is such that most cultural practices such as the rotation of crops and the chemical treatment of seed and soils have not given very satisfactory control. Of the various cultural practices used in potato production, the systematic rotation of crops is considered one of the most important means of maintaining the organic matter of the soil and increasing potato yields.

In 1934, a set of plots was so planned that the residual effect of organic matter and continued cropping could be studied. The plots consisted of four types of rotations: (1) alfalfa, (2) sweet clover, (3) rye, and (4) the continuous cropped or check plot.

The field at the Lake City Experiment Station selected for this

*The writer is indebted to Mr. A. M. Berridge, Superintendent, Lake City Experiment Station, Lake City, Michigan, for providing the land and assistance for this investigation.

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experiment had grown a previous crop of potatoes. The crop had been only moderately scabby. Enough scab was present to be typical of that which is present in much of the soil in Michigan where potatoes are grown. The organisms present caused the deep-pitted type of scab on the Irish Cobbler and Russet Rural varieties.

A field containing approximately 10 acres was divided into 12 equal-sized plots. The plots were approximately 30 rods in length by 60 feet in width, making it possible to have 20 rows of potatoes in each plot.

ROTATIONS

ALFALFA: Oats seeded to alfalfa; alfalfa two years; one year potatoes.

SWEET CLOVER: Oats seeded to sweet clover; sweet clover one year; one year potatoes.

RYE: Corn, rye seeded in corn last cultivation; one year potatoes.

CHECK: Potatoes grown on same plots year after year.

Hydrated lime was applied at time of seeding alfalfa and sweet clover at a rate of from 500-1,000 pounds per acre. The rye and check plots

Fig. 1. Excellent growth of rye that had been seeded on August 20, 1945, at East Lansing. (Photographed March 20, 1946.)

TABLE 1—*Plot numbering and crop rotation practices of each of the plots 1935-44.*

Plot No.	Crop rotation	Year's potatoes grown on plot
1	Check	Potatoes each year
2	Corn, rye—potatoes	1936—1938—1940—1942—1944
3	Alfalfa—alfalfa—alfalfa—potatoes	1938—1942
4	Sweet clover—sweet clover—potatoes	1937—1940—1943
5	Potatoes—alfalfa—alfalfa—alfalfa	1935—1939—1943
6	Check	Potatoes each year
7	Potatoes—corn, rye	1935—1937—1939—1941—1943
8	Sweet clover—potatoes—sweet clover	1936—1939—1942
9	Alfalfa—alfalfa—potatoes—alfalfa	1937—1941
10	Potatoes—sweet clover—sweet clover	1935—1938—1941—1944
11	Alfalfa—potatoes—alfalfa—alfalfa	1936—1940—1944
12	Check	Potatoes each year

did not receive any lime. Fair to excellent seedings were obtained on all of the plots.

Approximately 400 pounds of 2-12-6 commercial fertilizer was applied to the alfalfa and sweet clover at time of seeding. Five hundred to 600 pounds of 4-16-8 or 3-12-12 commercial fertilizer was applied to the potato crop. The fertilizer was placed 2 inches to the side and on the same level as the seed pieces. None of the plots received barnyard or stable manure.

To obtain information every year on each of the rotations, four plots were required for alfalfa, three plots for sweet clover, two plots for corn, rye, and three plots for the continuous cropping (check plots). The three check plots selected were as follows: one on each end of the field and the third near the middle. Numbering of the plots was from 1 to 12. The three check plots were plot numbers 1, 6, and 12.

Table 1 gives the plot numbers and the rotations used, also when potatoes were planted in the rotation. The plots where potatoes are first in the rotation were the plots planted to potatoes in 1935. For example, plot No. 5 was planted to potatoes in 1935 and again in 1939.

A determination of the pH of the plots was made at the start of the experiment. The soil varied from a heavy sandy loam with a pH of 6.0-6.5 to a light sandy loam with a pH of 5.0-5.2. The heaviest scab infestation was on the soil with the high pH and least on the soil with the low pH. The scab condition was observed from a previous potato crop grown on this field. The plot layout was made so that each plot contained approximately the same proportion of each kind of soil.

The Katahdin variety was grown in this experiment each year with the exception of 1935, when the Irish Cobbler variety was used.

Four, 40-foot plots were harvested from each treatment to determine the yield and percentage of tubers by weight free from scab after they had been sized for U. S. No. 1 grade. The only potatoes discarded were those below 1⅞ inches in diameter.

TABLE 2—*Effect of crop rotation on percentage of tubers free from scab by weight and yield of U. S. No. 1 size potatoes. Years 1935-44.*

Year	Alfalfa			Sweet clover			Rye			**Check	
	Yield U. S. No. 1 size, bushels per acre	*Plot No.	Percent U. S. No. 1 free from scab	Yield U. S. No. 1 size, bushels per acre	*Plot No.	Percent U. S. No. 1 free from scab	Yield U. S. No. 1 size, bushels per acre	*Plot No.	Percent U. S. No. 1 free from scab	Yield U. S. No. 1 size, bushels per acre	Percent U. S. No. 1 free from scab
1935...	226	5	95	131	10	74	151	7	95	169	93
1936...	119	11	95	111	8	95	105	2	98	99	94
1937...	151	9	92	136	4	95	74	7	75	108	79
1938...	201	3	95	159	10	33	91	2	77	87	66
1939...	161	5	98	148	8	63	114	7	78	130	77
1940...	147	11	92	131	4	43	100	2	94	92	51
1941...	192	9	91	167	10	4	117	7	98	157	67
1942...	128	3	60	102	8	6	83	2	90	60	56
1943...	100	5	80	104	4	16	51	7	81	73	57
1944 ..	117	11	46	77	10	4	86	2	83	58	63
Ave...	154	....	84	127	....	43	97	....	87	103	70

*Reference to plot No. in Table 1.
**Potatoes grown every year on same plot.

Table 2 gives the percentage of tubers by weight free from scab and the yields of U. S. No. 1 size potatoes for each year 1935-44 on each plot where potatoes were grown.

The plot numbers, when potatoes were grown in the rotation, are given in the column between the column for yield bushel per acre U. S. No. 1 size and the column listing percentage U. S. No. 1 free from scab in Table 2. For example, in 1936, plot No. 11 had 95 percent clean potatoes. In 1940, the plot was again planted to potatoes with a reading of 92 percent clean potatoes. The third crop of potatoes was grown on plot No. 11 in 1944 with a reading of 46 percent clean potatoes.

A critical examination of the data in Table 2 reveals that the plots where rye was used in a rotation for green manure gave the highest percentage of clean potatoes, 87 percent; followed by the alfalfa rotation, 84 percent; with the exception of the plot in 1944. That year 46 percent were clean as compared with 63 on the check plot. The plots having the least clean potatoes were those where sweet clover (43 percent free from scab) had been used in the rotation. A rather significant point to consider is the decreasing amount of clean potatoes on the sweet clover and check plots. Another point to consider is the small decrease in the clean potatoes on the rye and alfalfa plots as compared with the rapid decline in percentage of clean tubers on the check and sweet clover plots as successive crops were grown.

The scab on the tubers grown on the sweet clover and check plots was much more severe than that on the tubers of either the alfalfa or rye rotations. The type of infection on the tubers of the Katahdin

variety grown on these plots was deep causing the pitted scab. There was a smaller number of scab spots on the tubers showing scab on the alfalfa and rye plots. The sweet clover plots had tubers with the larger and more numerous pits, which were even more pronounced on the lighter soil type with the lower pH.

The average yield for the 10 years 1935-1944 was 154 bushels per acre on the rotation where alfalfa was used for green manure, 127 bushels where sweet clover was grown, 97 bushels per acre where rye was drilled between the corn rows at the last cultivation, and 103 bushels per acre on check plots where potatoes were grown on the plots each year.

DISCUSSION

Alfalfa and sweet clover are legume soil-building crops. They have been recommended and used by many potato growers. Higher yields of potatoes result on the plots where these legumes are used than where either the shorter rotation of corn seeded to rye at last cultivation or continuous cropping with potatoes is practiced. The results show alfalfa to be superior to sweet clover, based on the bushels of U. S. No. 1 potatoes per acre and the much higher percentage of clean tubers harvested.

The residual effect of rotation influence on the disease, as shown in percentage of U. S. No. 1 tubers free from scab, was greater on the plots where clover was grown the previous year. On plot No. 10, after two crops of potatoes had been grown in the rotation, the percentage of clean tubers had dropped from 74 percent in 1935 to 33 percent clean in 1938. When potatoes were grown again on this plot in 1941 only 4 percent of the tubers were clean. The fourth crop of potatoes in 1944 on the same plot was 4 percent clean.

A similar set of plots (plot 7) where rye was grown the year preceding a crop of potatoes, gave a much higher reading in percentage of clean potatoes. The high readings of 98 percent clean in 1941, 90 percent in 1942, 81 percent in 1943, and 83 percent clean in 1944 were very much better than the reading of 4 percent clean in 1941, 6 percent in 1942, 16 percent in 1943, and 4 percent clean in 1944 on the sweet clover rotation plots. Examination of "percent clean" on the alfalfa rotation in Table 2 shows it to be much higher on these plots than on the sweet clover, and only slightly less than the percentage of clean tubers on the plots of potatoes in the rye rotation. The percentage of clean tubers in the check plot was much higher than that in the sweet clover plots, and considerably lower than that in the alfalfa and rye rotation plots.

The U. S. No. 1 yield of potatoes fluctuated with the years. A favorable season would give a higher yield than one that was not favorable

for potato production. The yields were generally higher on the plots in the alfalfa rotation than in the others. Sweet clover plots usually gave a higher yield each year than the rye or the check plots. The yield on the rye plots and on the check plots varied considerably. One year the check plot would out-yield the rye plot and in another the rye plot would out-yield the check.

To incorporate the high yields from alfalfa and the high percentage of scab-free potatoes on the rye plots, a 10-acre field of alfalfa and brome grass hay at the Lake City Experiment Station was plowed down in June 1944. The field was fallowed with a field cultivator and disk harrow for 2 months to control quack grass and other weed growth. Approximately on August 15, 2 bushels of rye per acre was drilled on the fallowed land. The rye made an excellent growth, making an ideal turf by late fall. The rye was plowed down the following spring in 1945, and the field was planted to potatoes. At harvest there was less than 1 percent scab on the tubers—even on such susceptible varieties as Chippewa and Katahdins. A significant fact to consider is that a crop of potatoes grown in 1937 and again in 1941 on this field was much more severely scabbed in those years than it was in 1945.

No test was conducted to determine why scab should increase more on the sweet clover than on the alfalfa plots. The soil where the experiment was conducted was only mildly infested with scab, but no different than a large number of acres of land where potatoes are grown each year in Michigan. The results give no assurance scab can be controlled where a soil is used for potato growing that contains a high amount of scab organisms. It might not prove successful at first, but it would possibly require a much longer number of years growing alfalfa and rye in combination to give the same results as obtained with soil containing fewer scab organisms.

SUMMARY AND CONCLUSIONS

Katahdin potatoes were grown each year 1935-44 on a four-year alfalfa rotation; three-year sweet clover rotation; two-year rotation with rye drilled in corn at last cultivation, and check plots where potatoes were grown each year. Yield of U. S. No. 1 size potatoes, and percentage of U. S. No. 1 potatoes free from scab were recorded.

The average yield of U. S. No. 1 size potatoes was 154 bushels per acre on the plots where alfalfa was used in the rotation. The sweet clover rotation yielded an average of 127 bushels per acre of U. S. No. 1 size potatoes. Rye rotation with the rye drilled in at last cultivation of corn gave a yield of 97 bushels. The check plot where potatoes were grown each year yielded 103 bushels.

The average percentages of potatoes free from scab on the rotations were: 87 percent clean for rye; alfalfa 84 percent clean; check 70 percent clean; and only 43 percent clean on the sweet clover rotation plots. The greatest decline in percentage of clean potatoes from 1935 to 1944 was on the sweet clover plots, followed by the check, alfalfa, and rye plots.

No explanation is given as to why the sweet clover plots should produce fewer clean potatoes than the other rotations.

A cultural practice which will take advantage of the high percentage of scab-free U. S. No. 1 size potatoes on the rye rotation with the higher yields produced on the alfalfa rotation plots is recommended. To demonstrate this practice a crop of alfalfa and brome grass was plowed in June 1944. The field was fallowed until the middle of August. At that date 2 bushels of rye per acre was drilled on the field. The rye was plowed down in the spring of 1945, preceding planting of the potato crop. In the fall of 1945 very little scab appeared on the scab-susceptible Chippewa and Katahdin varieties. The field had grown a crop of potatoes in 1937 and in 1944. In each of those years scab was generally prevalent on the Chippewa and Katahdin varieties, but in 1945 it affected less than 1 percent of the tubers.

SWINE PASTURES SAVE FEED AND INCREASE PROFIT

By W. N. McMILLEN
SECTION OF ANIMAL HUSBANDRY

IT IS DIFFICULT to understand why more swine producers do not utilize pastures to the fullest extent when one considers the large amount of feed saved, the improved sanitation brought about, the soil conservation involved, and the many other profit-making features of growing succulent pasture.

The use of pasture is the best and practically the only way to overcome temporary grain shortages in swine feeding.

The purpose of this article is three-fold: (1) to point out results of pasture experiments conducted at Michigan State College the past 2 years and to list some of the reasons why pastures are valuable and in most cases necessary in swine feeding; (2) to suggest some ways to use pasture in helping to overcome local grain shortages that are common in this state; and (3) to stress the value and use of August-sown rye to lengthen the pasture season.

VALUE OF GOOD PASTURES IN SWINE PRODUCTION

Correctly managed swine pasture is often the most profitable acreage on farms where hogs are raised. This high value has been demon-

TABLE 1—*The influence of limited feeding on pasture and feeding on concrete floor upon the rate and economy of gain.*

Lot number	1	2	3	4
Treatment	Corn-supp. full feed on pasture	Corn-supp. 80% full feed to 115 pounds	Corn-supp. 60% full feed to 115 pounds	Corn-supp. and 5% alfalfa on concrete floor
Initial weight (lb.)	65	64	66	62
Final weight (lb.)	202	209	212	190
Average number days on feed	92	107	104	105
Average daily gain (lb.)	1.49	1.35	1.40	1.33
Feed per 100 lb. gain (lb.)	391	421	389	460

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strated many times. The experimental evidence included in this article helps emphasize the following reasons why succulent pasture is so valuable:

FEED SAVED—By the use of succulent green pasture, pork can be produced with at least 15 percent less concentrates. (Compare results of lots 1 and 4 in Table 1.) It has also been demonstrated many times that better hog pastures replace one-half of the protein supplement needed in dry-lot or where the pigs are fed on concrete floor.

SANITATION, PARASITE AND DISEASE CONTROL—Swine sanitation is more easily practiced with pasture feeding than with dry-lot or barn yard feeding. We usually find fewer than 2 percent runts developing in pasture fed lots. It is common to find 10 to 20 percent unthrifty pigs in dry-lot or on concrete floor. On too many Michigan farms wormy pigs are found under dirty barn yard conditions. A well planned pasture program is the best insurance against worm infestation and many swine diseases.

SOIL CONSERVATION — INCREASING SOIL FERTILITY—It is well recognized that crops used for pasture form one of the most effective means of controlling soil erosion. Experimental evidence indicates that a fattening pig will scatter at least $1 worth of manure on the pasture. A sow may return $4 worth or more in a year. A large percentage of the manure from dry-lot feeding is wasted.

LABOR AND EQUIPMENT SAVED—Properly used pastures reduce both labor and financial requirements compared with those needed in dry-lot feeding.

FASTER GAINS AND HIGH MARKET—Pasture-fed pigs will usually gain at least 17 percent faster than pigs that are receiving what is to be considered well-balanced rations in dry-lot or on concrete floor. (Compare figures for lots 1 and 4 in Table 1.) This faster rate of gain means that pasture-fed pigs usually reach market weight 2 or 3 weeks earlier and normally bring 25¢ to 75¢ more per 100 pounds.

PASTURE EXPERIMENTS WITH GROWING AND FATTENING PIGS

Four lots of 12 pigs each were started on feed July 14, 1944. Lots 1 to 3 were fed on rape pasture and Lot 4 on a concrete floor. All the lots received rations consisting of ground corn, supplemented with equal parts of 50-percent meat scraps and soybean oil meal. The pigs received 1½-percent mineral, the mixture consisting of equal parts ground limestone, steamed bonemeal and salt. The protein supplement was

mixed with the corn so that the pigs received approximately 17 percent protein until they weighed 80 pounds, 15 percent protein from 80 to 125 pounds, and 13 percent protein from 125 pounds to market weight.

Lot 1 was full-fed throughout the experiment. Lot 2 was limited to 80 percent the amount eaten by the pigs in Lot 1 until September 9 and full-fed to market weight. Lot 3 was fed 60 percent the amount eaten by Lot 1 until September 9 and full-fed until weighed out November 7. Lot 4 was fed on a concrete floor and received the same ration as the other lots with 5 percent alfalfa meal added. Table 1 shows the performance and economy of gain for the different lots.

RESULTS

USING PASTURE TO OVERCOME TEMPORARY AND LOCAL FEED SHORTAGES—In discussing the value of pasture, it was pointed out that the pasture-fed pigs in Lot 1 made 17 percent faster gains on 15 percent less feed than the pigs fed on a concrete floor in Lot 4.

A possibility for averting temporary feed shortages is to limit the grain on good pasture and to finish the pigs in the corn field or on the new corn crop. This practice results in very little, if any, saving of total feed as can be seen by comparing the feed required per 100 pounds of gain in Lot 1 with the feed requirements of lots 2 and 3.

For each 100 pounds of gain, the Lot 3 pigs on 60-percent full feed required 32 pounds less feed than the Lot 2 pigs which received 80-percent full feed. This indicates that the pigs on the more limited ration utilized more pasture.

RYE PASTURE VALUABLE FOR LENGTHENING THE PASTURE SEASON

In order to make maximum use of pasture in swine production it is necessary to start grazing early in the spring and continue late in the fall and early winter. August-sown rye, seeded at the rate of 1½ bushels per acre, has proved excellent for extending the pasture season the past two years. No records were kept in 1944-45, but some interesting observations were made with brood sows and fall pigs on rye pasture during the 1945-46 season.

RYE PASTURE FOR BROOD SOWS—It is well known that pastures are cheap insurance against breakdown of sows during late gestation, small weak litters, failure of sows to produce enough milk, unthrifty weanling pigs, and many other disorders. Many Michigan swine producers use pasture during the summer. Few of the above-listed troubles show up if the pigs are born early so that pasture is still available. Owing to a lack of pasture or good pasture substitutes during the winter, many troubles appear in the spring pig crop.

Fig. 1. Sows and gilts on lush rye pasture, November 10, 1945.

An acre of rye sown August 9, 1945, was ready for pasture on September 20. Five Hampshires (2 sows and 3 gilts) were turned into the pasture on October 1 and were left in until January 1, 1946. Even after the ground was covered with snow the sows would root the snow aside and eat some pasturage.

These sows and gilts remained in excellent flesh (Fig. 1) on about one-half the usual grain allowance. The sows were bred for May farrowing and returned to the pasture March 1, 1946. At the time this article is written, the pasture has furnished 6 weeks of spring grazing in addition to the 90 days in the fall and the pasture still looks capable of furnishing pasture for the pigs. Figuring that these sows and gilts would normally need about 6 pounds of grain each per day under dry-lot conditions, this rye pasture has saved 15 pounds of feed per day or a total of 1,950 pounds of total feed to date. In spite of the fact that the last two winters have been exceptionally favorable for grazing, it is felt that the use of rye pasture should prove extremely profitable almost any year.

RYE PASTURE FOR FALL PIGS—Four one-fourth acre lots were seeded to rye on August 9, 1945. Records were kept on the pasture furnished 11 barrows on one of these pastures.

A sow and litter of 8 pigs pastured the one-fourth acre from the middle of September to November 1. Eleven 81-pound pigs were weighed into the pasture on November 9 and kept there until December 27. Notice the lush growth of the rye and the thrifty condition of the pasture-raised pigs in Fig. 2.

If the pasture saved only 10 percent of the total feed, this one-fourth acre would have saved 317 pounds of concentrates during this period. In addition to the saving of feed, the pigs stored enough

vitamins to carry them through to market weight in February without further ground hay supplement. Using rye pasture for fall and spring grazing can save a lot of hay grinding by eliminating the use of legume hay or meal for several weeks while the pasture is available.

Fig. 2. Healthy fall pigs on rye pasture, November 10, 1945.

SUGAR-BEET HARVESTER TRIALS IN MICHIGAN IN 1945

By C. M. HANSEN, L. E. SMITH and R. W. BELL
SECTIONS OF AGRICULTURAL ENGINEERING AND FARM CROPS

DURING 1943, 1944 and 1945 the Agricultural Engineering and Farm Crops sections of Michigan State College Agricultural Experiment Station, in cooperation with the Division of Farm Power and Machinery, U. S. Department of Agriculture, conducted field trials of two sugar-beet harvesters of the type shown in Fig. 1. The results for 1943 and 1944 are reported in the *Michigan Agricultural Experiment Station Quarterly Bulletin*, August 1945, pages 52 to 58. The following constitutes a report of performance checks and observations made of sugar-beet harvesters used in Michigan in 1945.

Rainfall during September 1945, in 18 beet-producing counties was, on the average, 3.0 inches above normal. Rainfall during October

Fig. 1. Type of sugar-beet harvester studied in this investigation.

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TABLE 1—*Results of sugar-beet harvester performance checks.*

Fields	Soil series	Soil moisture content—percent of oven-dry weight	Percentage tare			Pounds of screenings per ton of untared beets	Marketable tissue unharvested per acre				Approximate acre-yield—tons	Number of beets per 100 feet of row
			Crown	Dirt	Total		On unharvested beets		On "tops"—	Total—tons		
							Number	Tons				
A	Carlisle (Muck)	98	2.5	3.5	6	260	186.7	.160	.490	.650	16.5	67
B	Carlisle (Muck)	87	3.0	5.0	8	164	186.7	.244	.127	.371	15.0	65
C	Brookston	19	7.5	4.5	12	468	1120.0	1.120	.397	1.517	16.0	98
D	Brookston	28	8.5	5.5	14	614	933.5	1.295	.187	1.482	13.0	65
E	Brookston	17	9.0	5.0	14	360	93.3	.128	.583	.711	12.0	81
F	Brookston	20	2.0	9.0	11	500	0.0	.0	.023	.023	6.8	85
G	Brookston	14.5	2.0	8.0	10	172	186.7	.327	.093	.420	15.6	88
H	Miami and Conover	22	2.0	10.0	12	382	0.0	.0	.298	.298	4.6	68
I	Miami and Brady	12	2.0	11.0	13	258	1120.0	.466	.093	.559	7.0	100
J	Miami and Brady	13.4	2.0	10.0	12	300	2613.8	1.306	.224	1.530	7.0	100
Average			4.05	7.15	11.2	348	642.	.505	.252	.756	11.35	

and November was 0.43 inch above normal and 0.67 inch below normal, respectively. Because of above-normal rainfall and an unseasonably large number of cloudy days during the three months, the fields on which the machines were operated were frequently so wet as to affect adversely the performance of mechanical harvesters.

PERFORMANCE CHECKS

Ten machines of the type shown in Fig. 1 were operated in Michigan during 1945, harvesting a total of 628 acres. This type of machine first loosens the beets from the soil by means of a single-point plow-lifter. The beets are then pulled, by the leaves, from the soil, after which they are passed between two rotating disks which sever the crowns and leaves from the roots. The "tops" are scattered on the soil surface at the rear of the machine. The harvested beets are elevated directly into an accompanying truck or wagon.

During the harvesting season performance checks were made of seven of the ten machines in the following manner. In each field two 100-foot check-lengths of unharvested rows were selected as being representative of the field as a whole, and soil moisture samples were obtained from several places in each. The number of beets in each check-length was then ascertained, after which these beets were harvested by the machine and the "tops" gathered. The marketable tissue below the lowest leaf scars was then cut from the "tops" and weighed. In addition, those beets in the check-lengths which the machine failed to harvest, that is, remove from the soil, were gathered, counted, and the weight of the marketable tissue determined. The beets mechanically harvested, including those from the check-lengths, were loaded directly from the harvester into a truck, and were delivered to the weighing station. Here the percentage of crown and dirt tare were determined for the load. These values were applied to the beets harvested from the check-lengths.

Table 1 presents the values obtained in making performance checks of the several harvesters.

Tare

In the performance checks, dirt tare ranged from 3.5 to 11.0 percent, averaging 7.15 percent. Whereas the latter value may be slightly higher than the average of hand-harvested beets, it is believed that it is not sufficiently high to justify discouragement of more widespread use of mechanical harvesters.

With respect to the 10 fields, no correlation existed between percentage of dirt tare and soil moisture content. However, the relation-

ship which existed between percentage dirt tare and acre-yield of roots is shown by the correlation coefficient, — 0.86.* This indicates that percentage dirt tare is definitely associated with acre-yield of roots, and that in mechanical harvesting operations and in the subsequent screening at the factory a greater amount of dirt adheres to a given weight of small beets than to the same weight of large beets.

High percentage of crown tare is regarded as undesirable, since any harvested beet on which a portion of the crown remains, may, under certain conditions, initiate leaf growth in the factory pile. In addition, the presence of various salts in the crown renders more difficult the sugar extraction and refining process.

No explanation is offered for the high percentage of crown tare on fields C, D, and E, although it is known that two of the three operators had had very little experience in adjusting and operating a harvester. With the exception of these three performance checks, the crown tare values obtained were satisfactory.

Screenings

Screenings comprise loose dirt, leaves and other material separated from the harvested beets at the factory by means of mechanical devices. They are ordinarily returned to the empty beet truck to be hauled back to the field.

A study of Table 1 indicates that on the Brookston series, and also on the Miami, Conover and Brady series, a positive correlation existed between soil moisture content and pounds of screenings. In general, amount of screenings was relatively high on the mineral soils, a fact which has led manufacturers to attempt the development of more effective dirt-removing devices for their respective harvesters. It will be noted that the average amount of screenings was 348 pounds per ton of untared beets. For the mineral soils, only, the amount of screenings was 382 pounds per ton of untared beets. It should be pointed out that from hand-harvested beets, screenings in 1945 were also higher than in most years, in some cases exceeding the figures shown above.

Screenings Plus Dirt Tare

The total amount of dirt hauled to the factory with the beets is represented more or less accurately by the screenings plus the tare dirt. For several reasons excessively high screenings and excessively high percentage dirt tare are objectionable. Figure 2 shows the relationship which existed between soil moisture content and the pounds of screenings plus pounds of tare dirt per ton of untared beets. The tare and

*Statistically significant at the 1-percent level.

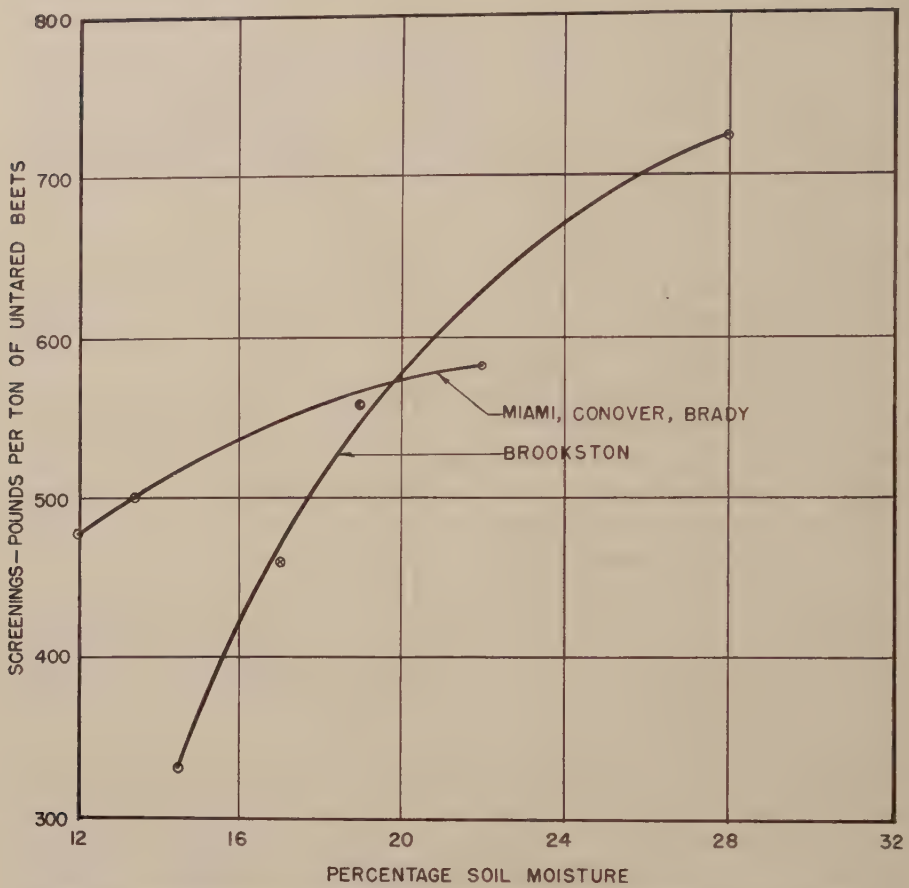

Fig. 2. Relationship between soil moisture content and screenings plus tare dirt.

screening figures obtained from the machine which was operated in field F are omitted from Fig. 2, since certain alterations of the machine rendered it less effective in eliminating dirt. For the Brookston series the total amount of dirt hauled to the factory increased rapidly with increasing soil moisture; less rapidly for the Miami, Conover and Brady series. The three latter series are characterized by soils of lighter texture than those of the Brookston series.

Interestingly, when the soil moisture content was between 12 and 19 percent, the total amount of dirt hauled to the factory from fields of Miami, Conover and Brady soils was greater than from the heavier Brookston soils. This is probably due to the fact that the lower plastic limit of soils of the Brookston series is higher than that of Miami, Conover and Brady soils. This means that with increasing soil moisture content the Miami, Conover and Brady soils enter into the plas-

ticity state more quickly than do the Brookston soils; a state which results in large amounts of soil adhering to the beet roots as they are harvested. The fact that the *total* amount of dirt hauled to the factory is higher for the Brookston soils is due to the greater amount of clay in the series.

Unharvested Marketable Tissue

Unharvested marketable tissue comprises (1) marketable tissue of those beets which the machine failed to harvest, and (2) marketable tissue remaining on the "tops".

On the average, the machines failed to harvest 642 beets per acre. These beets were frequently characterized by either (1) a large crown protruding 4 to 8 inches above the soil surface, or (2) a prostrate type leaf growth. In the former case the leaves were stripped from the crown by the action of the elevator chains, while in the latter case, the gathering points failed properly to direct the leaf growth to the elevator chains. It will be noted that the machine which was operated on fields F, G, and H, and which employed the use of elevator belts rather than chains, gave better than average performance in this respect. The machine which was operated on field J also used elevator belts, but the experimental gathering points were ineffectual in properly guiding the leaves of the relatively small beets. The two machines which were operated on muck left a smaller than average number of beets unharvested, primarily because of the profuse leaf growth and the fact that the beets were easily lifted from the loose soil. Generally speaking, farmer-operators did not criticize severely the performance of the machines with respect to removal of beets from the soil, since the unharvested beets could be gathered readily by hand, the expense of which was more than offset by savings in harvesting costs.

The amount of marketable tissue remaining on the "tops" averaged about 500 pounds per acre. A limited number of comparisons indicates that this figure is no greater than that for beets harvested by hand, and hence should not be regarded as excessive.

MAXIMUM UTILIZATION OF ROUGHAGE AND PASTURE BY STEERS

By G. A. BRANAMAN and C. M. HARRISON
SECTIONS OF ANIMAL HUSBANDRY AND FARM CROPS

LITTLE INFORMATION is available on the use for pasture of legumes grown in the crop rotation. One of the projects in beef production is to convert humanly inedible roughage into beef. Hay or other cured roughage is necessary for winter feeding, but in many cases steers on dry feed in summer could use pasture to even better advantage than they use hay, and considerable labor in handling hay and manure could be saved. Economical use of grain to produce a desirable market finish on the steer at the most opportune time in his life is quite important.

An experiment was started at Michigan State College in December 1944, to study these problems in detail. A group of 48 steer calves, averaging 435 pounds in weight, were divided into 4 lots of 12 calves each for the wintering period, and later into 6 lots of 8 calves each.

THE WINTER PHASE OF THE TEST

The results of the wintering phase were summarized in the *Michigan State College Agricultural Experiment Station Quarterly Bulletin,* for August

TABLE 1—*Wintering phase.*

Per steer basis, 152 days, Dec. 27-May 28	Lot A	Lot B	Lot C	Lot D
Number of steers	12	12	12	12
Average initial weight	434.2	436.4	440.6	435.7
Average final weight	664.2	685.4	585.4	566.7
Gain per steer	230.0	249.0	144.8	131.0
Average daily gain	1.51	1.64	0.95	0.86
Daily ration:				
Corn, ground	6.1	1.2	2.1	.....
Soybean meal	.....	1.2	.....	.....
Corn silage	.....	22.5	.....	16.1
Hay	10.7	3.6	12.5	6.9
*Cost 100 lb. gain	$16.16	$11.24	$18.02	$15.00
**Cost cwt.—steer weight	14.75	13.00	14.99	14.23

*Feed prices: Corn $45; soybean meal $60; silage $7.50; hay $20 per ton.
**Feeder calf $14 cwt. plus feed cost—divided by steer weight.

1945. Brief data on that part of the experiment are given here in Table 1 in order to make the story complete.

Two lots of calves were fed to gain distinctly faster than the other two lots. Two rations were compared for the faster gaining calves and two rations for the slower gaining calves. The better fed calves in lots A and B produced gains at less cost than those fed more limited rations in lots C and D. Lots B and D, which received principally corn silage, produced cheaper gains than those in lots A and C, which were fed corn and hay.

The cheapest gain among all lots was made by calves in Lot B, $11.25 per 100 pounds, and they were full-fed on corn silage, with soybean meal, hay, and limited corn the last 6 weeks. The most expensive gains, $18.02 per 100 pounds, were made by calves in Lot C fed limited corn and hay. When the cost of the feeder calf, plus the cost of winter feed, was divided by the weight of the calf in May, the cost of the calf per hundred weight at that time varied less than did the cost of 100 pounds of gain. Nevertheless, the lots remained in the same order with reference to economy of production.

Fig. 1. A typical group of the heavier calves, Lot 1 cattle after 30 days of grain while on grass.

Fig. 2. A typical group of the lighter calves, Lot 5 after 30 days grazing.

RE-ALLOTMENT OF CALVES FOR GRAZING AND FINISHING

The 24 calves in lots A and B were divided into 3 lots of 8 head each for summer grazing and finishing by sorting 4 calves from each winter lot. A similar procedure was used in re-sorting those from lots C and D, making the lots as uniform as possible with respect to weight, previous gain, type and condition.

One lot of heavier calves, Lot 1, was fed in a similar manner to a group of lighter and thinner calves, Lot 4. In a similar manner lots 2 and 5, as well as lots 3 and 6, were paired and the paired lots given similar treatment. All lots were turned on pasture May 28.

PASTURE MANAGEMENT AND FATTENING RATIONS

Lot 1—Heavy calves—Pasture, ground corn, and soybean meal until marketed September 10.

Lot 2—Heavy calves—Pasture alone 60 days. Ground corn and soybean meal and on pasture to October 15. Silage and hay added in dry-lot until marketed October 29.

Lot 3—Heavy calves—Pasture alone 108 days. Ground corn and soybean meal on pasture to October 15. Silage and hay added in dry-lot until marketed December 10.

Lot 4—Light calves—Same as Lot 1 until October 15 when silage and hay were added in dry-lot until marketed October 29.

Lot 5—Light calves—Same as Lot 2 until marketed December 10.

Lot 6—Light calves—Same as Lot 3 until marketed December 26.

The calves in lots 1, 2, 4 and 5 each grazed on 5.5 acres of mixed legume and grass pasture seeded the previous year. Red clover predominated, with alfalfa and some smooth brome grass in the mixture. Alsike clover and alfalfa, with timothy predominating, was available for lots 3 and 6. There was surplus acreage for these two lots so that legume forage was available for grazing at all times. Ample shade and forage were available throughout the season. Grazing was discontinued and all cattle were removed to the experimental barn October 15.

Ground corn and soybean oil meal were fed once daily in the morning to those lots receiving grain on pasture. All feeds were fed twice daily after the cattle were moved to the barn. Twelve pounds of corn and 2 pounds of soybean meal daily were the greatest amounts fed, with an additional 2.5 to 3 pounds in the silage ration.

GRAZING RESULTS

The calves in the first three lots were about 100 pounds heavier than those in the last three lots when they went to pasture. The heavier and fatter calves in lots 2 and 3 made slower and more expensive gains than the lighter and thinner calves in lots 5 and 6 when on pasture only, as shown in Table 2.

Calves in Lot 2 seemed to be light in weight at the end of 60 days as compared with the other calves, and subsequent gains tended to

TABLE 2—*Grass-alone phase.*

Per steer basis beginning May 28	Lot 1	Lot 2	Lot 3		Lot 4	Lot 5	Lot 6	
Number of steers	8	8	8		8	8	8	
Number of days		60	60	108		60	60	108
Average initial weight	Grain	675	673		Grain	572	587	
Average final weight	fed on	744		808	fed on	681		771
Average daily gain	grass	1.15	1.63	1.25	grass	1.81	1.89	1.70
*Cost cwt. gain		$5.25		$4.80		$3.31		$3.53
Cost cwt. steer weight		13.06		12.35		12.82		11.99

*Pasture alone at 6 cents per steer daily, with feed 5 cents.

prove this. Those in Lot 3 came nearer to lots 5 and 6 in gains for the first 60 days, although they dropped off materially later, thus making slower gains for the 108-day period as compared with Lot 6.

Combining winter feed cost and pasture cost, together with cost of the feeder calf in December, and dividing by the weight at the end of the pasture period in each lot, gives the cost of the steer at that time. The cost of the steer was reduced to a lower figure in lots 5 and 6 owing to more gain on pasture at the low cost for gain. These lighter calves stood at a higher cost in May than did the heavier calves, as shown in Table 1. There was a greater difference in favor of those on pasture only for 108 days in lots 3 and 6, as compared with corresponding lots 2 and 5 on grass for 60 days.

Calves in lots 1 and 4 received grain during this time. Gains in Lot 1 averaged 1.97 pounds and those in Lot 4 were 2.48 pounds daily during the first 60 days. Lot 1 cattle were marketed in 105 days with an average gain of 2.06, while those in Lot 4 gained 2.5 pounds for 108 days.

FATTENING AND MARKETING

Data on the fattening period for the various lots are shown in Table 3. Grain feeding began on the date indicated in each lot, which was at the start of the pasture period in lots 1 and 4; after 60 days

TABLE 3—*Grain feeding phase.*

Per steer basis	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6
Number of steers*	8	8	8	8	8	8
Grain started	May 28	July 27	Sept. 13	May 28	July 27	Sept. 13
Removed to dry-lot	.....	Oct. 15	Oct. 15	Oct. 15	Oct. 15	Oct. 15
Marketed Detroit	Sept. 10	Oct. 29	Dec. 10	Oct. 29	Dec. 10	Dec. 26
Days on feed	105	94	88	154	136	104
Average daily gain	2.06	2.41	2.32	2.39	2.35	2.50
Average final weight	892.5	970.6	1011.3	937.5	1060.6	1031.3
Average shrink to Detroit	19.	23.	18.5	31.	22.	25.
Average daily ration for days actually fed:						
Corn, ground	10.6	10.0	10.4	10.7	10.7	10.5
Soybean meal	.7	.8	1.5	.9	1.2	1.5
Silage	.....	14.3	21.0	13.9	19.4	24.0
Hay	.....	3.4	4.9	3.4	4.5	4.3
Cost cwt. gain	$15.09	$12.59	$16.74	$13.43	$15.07	$15.61
Cost cwt.—steer weight, or necessary selling price	14.16	12.95	13.16	14.13	13.54	12.90
Dressing (percent)	60.5	59.0	58.0	58.0	58.0	56.0

*One steer found dead Lot 5, Sept. 13; one removed Lot 3, Oct. 29, acute bloat.

pasturing in lots 2 and 5; and after 108 days pasturing in lots 3 and 6.

An attempt was made to market each lot when the steers would grade about "low choice" or AA in the carcass. They were weighed early in the morning without grain feed and went by truck directly to the Detroit Stock Yards for sale. This home weight is the final weight shown in the table. Dressing percentages are shown on the basis of the Detroit weights and cold carcasses.

They were marketed at four different times from September 10 to December 26, and conditions on the market were such that actual sale prices varied from $17 to $18.30. Opinions of those in contact with the experiment, salesmen, and buyers were that an equitable method of evaluating the cattle would be to use the dressing percentages as a guide to price. These prices are shown in Table 4, with Lot 1 as the base at $16 per 100 pounds in the feed-lot, and dressing percentages shown in Table 3.

The truck haul was about two and one-half hours over good road, and the cattle were sold and weighed within another hour without feed or water.

There are considerable differences between the cost for 100 pounds of gain during the fattening period and the cost for 100 pounds of steer weight, as shown in Table 3. The former is the feed and pasture cost for gain made during this period only. The latter figure is the necessary selling price, including the cost of the feeder calf, and all feed and pasture costs since the start of the experiment. A comparison of these two items shows clearly the fallacy of attempting to establish the profit from any one period or item in a cattle feeding program.

The high dressing percentage shown in Lot 1 may have been due partly to less digestive fill as taken from pasture than that of the other lots after being fed dry feed. If that were true, it might explain to some extent also the slower gain made by Lot 1 while on feed. Shrink to market was similar and if there was a difference in fill, it was retained past the selling weight.

The low dressing yield of the cattle in Lot 6 was due largely to lack of finish. They should have had about 30 days longer feed to compare more closely with the other cattle. They were fed only 104 days, as compared with 154 and 136 days for lots 4 and 5, and they did not fatten noticeably while on grass alone.

Slow gains mean growth rather than fattening, and heavier weights among the lots are evident as the cattle became older at the time of finishing and marketing.

TABLE 4—*Financial balance of entire experiment.*

Per steer basis	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6
Winter level	Liberal	Liberal	Liberal	Light	Light	Light
Pasture only	None	60 days	108 days	None	60 days	108 days
Average initial weight (lb.)	436.4	432.6	436.8	439.3	433.9	441.4
Average total gain (lb.)	456 1	538 0	574 5	498 2	566.7	589 9
Corn per cwt. gain (lb.)	366	277	256	364	286	213
Average cost at $14.00	$61.10	$60.57	$61.15	$61.49	$60.74	$61.79
Winter feed	32.62	32.96	32.15	21.57	22.88	24.12
Pasture	5.25	7.60	8.08	7.00	7.60	8.08
Finishing feed	27 37	24 56	31.68	42.43	44.26	39.03
Total cost steer and feed	126.34	125.69	133.06	132.49	135.48	133.02
Sale value on basis of dressing percent and Lot 1 at $16 in lots	$ 16.00	$ 15 70	$ 15 40	$ 15.40	$ 15 40	$ 14 80
Sale value per steer	142 80	152 39	155 73	144.37	154 10	152.62
Return above cost of calf and feed, per steer	$16.46	$26.70	$22.67	$11.87	$18.62	$19.60
Return per steer if wintered on silage	22.12	32.42	28.24	13.92	20.79	21.87
Return per steer if wintered on corn and hay	10.32	20.50	16.62	10.00	16.63	17.49

FINANCIAL RETURNS

The cost of the feeder calf and feed costs for each period in the experiment are summarized in Table 4. Sale value is calculated as described previously, and the return per head is the difference between sale value and cost of calf and feed.

Additional comparisons are shown based on the differences in performance during the initial wintering period. As described previously, equal numbers from each of two winter lots constituted a lot for the grazing and finishing period.

In the case of the first three lots, the difference in winter costs amounted to about $12 per head. In the last three lots the difference was about $4 per steer, varying slightly with the weight and gain of steers in each lot.

Lots 2 and 3 were most profitable, while lots 1 and 4 were least profitable.

SAVING GRAIN

The total feed required per steer is indicated in Table 5. A combination of each winter ration with each finishing ration is shown according to re-allotments of cattle in May. From these data, costs at different feed prices may be calculated as well as making a study of tonnages required.

TABLE 5—*Total feed per steer.*

Lot		Ground corn	Soybean meal	Corn silage	Hay
1-A*	Winter	928	.....	.....	1628
	Finishing	1114	78	.....	.....
	Total	2042	78	.....	1628
1-B	Winter	186	184	3426	542
	Finishing	1114	78	.....	.....
	Total	1300	262	3426	542
2-A	Winter	928	.....	.....	1628
	Finishing	935	76	200	48
	Total	1863	76	200	1676
2-B	Winter	186	184	3426	542
	Finishing	935	76	200	48
	Total	1121	260	3626	590
3-A	Winter	928	.....	.....	1628
	Finishing	915	130	1186	274
	Total	1843	130	1186	1902
3-B	Winter	186	184	3426	542
	Finishing	915	130	1186	274
	Total	1101	314	4612	816
4-C	Winter	316	.....	.....	1898
	Finishing	1655	133	194	48
	Total	1971	133	194	1946
4-D	Winter	.....	.....	2442	1049
	Finishing	1655	133	194	48
	Total	1655	133	2636	1097
5-C	Winter	316	.....	.....	1898
	Finishing	1461	160	1089	251
	Total	1777	160	1089	2149
5-D	Winter	.....	.....	2442	1049
	Finishing	1461	160	1089	251
	Total	1461	160	3531	1300
6-C	Winter	316	.....	.....	1898
	Finishing	1095	160	1729	312
	Total	1411	160	1729	2210
6-D	Winter	.....	.....	2442	1049
	Finishing	1095	160	1729	312
	Total	1095	160	4171	1361

*Numbers refer to summer lots—letters to winter lots.

Comparing the A cattle with the B cattle in the first three lots, about 740 pounds more corn and 1,100 pounds more hay were eaten by the cattle in Lot A, while those in Lot B ate instead about 290 pounds of soybean meal and 3,400 pounds of corn silage.

Those wintered in Lots C ate about 320 pounds more corn and 850 pounds more hay, while those in Lot D ate 2,442 pounds additional silage.

The steers in Lot 6 required least corn of all lots, while those in lots 1 and 4 required the most. As stated before Lot 6 cattle did not have a finish comparable with the other cattle, and a similar amount of corn would have fed them for about 30 days.

With the exception of Lot 6, fully as much or more total corn was eaten by the lightly wintered calves in lots 4 and 5 as by those wintered more liberally. In other words, grain, as such or in the silage, was necessary sooner or later to produce market finish.

Heavier weights and consequently greater total gain of cattle marketed later would tend to make more gain for the grain eaten. The extra weight was produced chiefly with pasture and roughages.

DISCUSSION

The calves gaining about 1.6 pounds daily during the winter made cheaper gains than calves fed similar feeds in amounts to produce 0.9 pound daily. There was a difference in weight of approximately 100 pounds in May. Calves fed liberally on corn silage produced cheaper gains than those fed hay and corn to make similar gain.

The feed cost for gains was higher than the cost of the calves per 100 pounds. Since the amount of gain per calf was less than the initial weight, and since the gain per calf varied among the different lots, the cost per 100 pounds of steer weight in May varied less than the feed cost for gains.

The calves gaining faster during the winter were ready for market sooner than the lighter and thinner calves, and they tended to make more total gain for the corn eaten. They showed a greater money return above cost of calf and feed than the corresponding lots of lighter calves.

Grazing without grain cut the costs considerably for cattle of both weights. The lighter and thinner calves made considerably faster gains on pasture alone than did those wintered on better rations. Faster gains on pasture alone were made the first 60 days, or during June and July, than during the next 48 days. The lighter calves did not overtake the heavier calves in either weight or finish in 108 days of pasturing.

The total cost per 100 pounds of steer weight at the end of the grazing period was not materially different between lighter and heavier steers grazed a similar period of time. There were no marked differences in rate of gain during the grain feeding periods except for a slower gain in the lot of heavier calves fed grain from the start of pasture, and a faster gain in the light lot grazed 108 days before grain feeding. The latter lot was not as well finished as the other cattle

and doubtless would have gained more slowly if fed longer. The lighter calves were fed approximately 45 days longer than the heavier calves, except for Lot 6.

Feed cost for gains during fattening varied from $12.59 to $16.74. The calves grazed 108 days without grain, and those in the well-wintered lot especially, were highest in costs. Lowest cost was for the well-wintered calves grazed 60 days before grain feeding. Necessary selling prices, or total cost per 100 pounds of steer weight, varied greatly and were not definitely related to any one phase of the experiment.

Variation in time of marketing resulted in very irregular selling prices, and, therefore, differences among lots were based on dressing percentages.

The most profitable group of calves were well-wintered, grazed 60 days, and fed corn and soybean meal 94 days. They dressed 59 percent and showed a return of $26.70 above cost of feeder calf and feed. Other lots ranked as follows: well-wintered and grazed 108 days, $22.67; lightly-wintered and grazed 108 days, $19.60; lightly-wintered and grazed 60 days, $18.62; well-wintered and grain-fed with pasture, $16.46; light-wintered and grain-fed with pasture, $11.87.

The well-wintered calves on the silage ration in winter showed an additional $12 per head return above those receiving corn and hay. There was about $4 advantage in case of the lightly-wintered calves.

The margin between cost and selling prices in the lots varied from $0.80 to $2 per 100 pounds. With a liberal allowance for labor and overhead, and crediting manurial values, there would be left some profit above costs, except possibly in Lot 4.

The experiment is being repeated with a similar group of calves in order to test certain findings revealed in previous work.

BULLETIN REVIEWS

SPECIAL BULLETIN 336

Michigan Farm Organization and Practices in Type-of-Farming Area 9

Brown, L. H.

An analysis of farm records in an area in the central portion of the lower peninsula where general farming and livestock enterprises are predominant. For an income sufficient to maintain reasonably satisfactory living standards the enterprise should be large enough to provide 275 to 350 productive days of work per year. This means 50 to 100 or more acres of tillable land, depending on the kinds of crops or livestock that are raised and an investment of from $10,000 to $20,000 per farm. (32 pp., 6 tables.)

TECHNICAL BULLETIN 202

Occurrence of Malaria Mosquitoes in Southern Michigan

Sabrosky, C. W.

There is presented the results of a mosquito survey in southern Michigan carried out cooperatively between the Michigan State Department of Health and the Agricultural Experiment Station. Data are presented on occurrence and prevalence of four species, together with keys for identification and suggestions for control. (50 pp. 8 tables.)

JOURNAL ARTICLE ABSTRACTS

Lactic Acid in Dairy Products. II. Relation to Flavor, Acidity Measurements, Bacterial Count and Methylene Blue Reduction

Gould, I. A. and Jensen, J. M.

Jour. Dairy Sci., 27 (9): 753-767. 1944. [*Journal Article 684 (n. s.) from the Michigan Agricultural Experiment Station*]

Results are presented on the relationship of the formation of lactic acid in milk to (a) the production of acid-associated flavors, (b) the microscopic clump count, (c) the methylene blue reduction, and (d) titrable acidity.

Acid-associated flavors were detected at low levels of lactic acid formation. Many samples of milk exhibited such flavor defects at lactic acid increases of 2-5 mg./100 gm. or less and practically all samples possessed acid-associated flavors at lactic acid values of 10 mg./100 gm. However, the type of flavor, the temperature of incubation, and the type of organisms were considered possibly to influence those values.

Bacterial clump counts, in general, range from about 15 to 10 million per ml. in those samples showing slight acid-associated flavors. The same factors which influence the acid flavor-lactic acid relationship were also of importance in this connection.

The methylene blue reduction time was markedly shortened in all samples of milk showing appreciable increases in lactic acid.

A general relationship was noted in the lactic acid increases obtained by the colorimetric lactic acid method and by titration. However, it was thought the titration results might vary appreciably from the true lactic acid changes in individual milks.

A discussion is given of the limitations and application of certain of these quality tests in a lactic acid grading program.

Fowl Cholera in Michigan

Darby, G. W.

M. S. C. Veterinarian, 4 (3): 120-124, 139. 1944. [*Journal Article 694 (n. s.) from the Michigan Agricultural Experiment Station*]

An outbreak of fowl cholera in chickens, the first diagnosed in Michigan at the Poultry Pathology Laboratory of Michigan State

College in 7 years, is described. Clinical manifestations, differential diagnosis and control of fowl cholera outbreaks are described. A procedure for bacteriological examination is presented. Some of the cardinal characteristics used in preliminary identification of organisms commonly isolated from avian tissues are presented in tabular form.

The Field Inoculation of Rye with Claviceps purpurea

LEWIS, R. W.

Phytopathology, 35: 353-360. 1945. [*Journal Article 721 (n.s.) from the Michigan Agricultural Experiment Station*]

Ergot, caused by *Claviceps purpurea*, is a useful drug. A method of creating an epidemic of this disease of rye and other grasses can be useful in the production of ergot and in scientific problems such as the breeding of grasses for resistance to ergot.

Large cultures of this fungus were grown in quart bottles on sterilized wheat. When 6 weeks old, the cultures, having produced a maximum number of spores, were beaten in a blender with added water, screened through a 40-mesh screen, and mixed with an equal weight of beet sugar. The sugar-inhibited germination of the spores prolonged their life in storage and prevented death by desiccation after the spores were applied to the plants in the field, but allowed the spores to germinate when diluted with water.

For application in the field the sugar-spore-suspension was diluted with water and sprayed on rye plants at the peak of their blooming period. Both a hand sprayer and a specially designed power sprayer were used successfully. Fifty-nine percent of the heads became infected in a plot sprayed five times with a knapsack sprayer, and 33 percent became infected in plots sprayed three times with a power sprayer. Adjacent control plots were 10 percent and 3 percent, respectively. These results indicate there is a good possibility of being able to grow ergot as a commercial crop. Further work needs to be carried out in selecting a susceptible variety of rye and in developing harvesting machinery.

Antibacterial Substances in Plants

HUDDLESON, I. F., DUFRAIN, J., BARRONS, K. C., AND GIEFEL, M.

Jour. Amer. Vet. Med. Assoc., 105 (813):394-397. 1944. [*Journal Article 735 (n.s.) from the Michigan Agricultural Experiment Station*]

It has been shown that garlic and certain varieties of onions contain growth-inhibiting substances in their juices for both gram-positive

and gram-negative bacteria. These can be extracted and purified to the point where a dilution of 1-1, 160,000 will inhibit the growth of *Br.* abortus and *Staph. aureus.* in a liquid medium.

A new antibacterial agent is described from one variety of rhubarb.

Granulosa Cell Tumor of a Bovine Ovary

LANGHAM, R. F. AND CLARK, C. F.

Am. Jour. Vet. Research, 6 (19): 81-83. 1945. [*Journal Article 738 (n.s.) from the Michigan Agricultural Experiment Station*]

Granulosa cell tumors of the bovine ovary are very rare. In available literature only two reports of such phenomena were found, one report from Scotland and one from the United States.

The present report deals with such an ovarian tumor found in a two-year-old Holstein-Freisian heifer. This heifer, believed by the owners to be pregnant, was found to be barren. Symptoms of constant estrus and others indicating nymphomania were observed. Upon slaughter a large tumor of the right ovary was found. On microscopic study the structure showed the characteristics of a granulosa cell neoplasm and the presence of Call-Exner bodies. It is postulated that the tumor cells may have produced an estrogenic hormone-like substance accounting for the symptoms shown.

Imitation Clove Oil Effective in Spicing Pickles

FABIAN, F. W. AND HARRIS, VIVIAN

Food Industries, 17: 638-640. 1945. [*Journal Article 742 (n.s.) from the Michigan Agricultural Experiment Station*]

Owing to the shortage of natural spices during the war, imitation spice oils were used in large quantities. Work was undertaken to determine just how completely the imitation spice oils were absorbed as compared with the natural spice oils. For this purpose the essential oil of clove was chosen for the tests since it is one of the most commonly used spices by the pickle maker and also because it is composed of three chemically distinct components (terpene, alcohol and ester) with rather wide variations in physical and chemical properties. The imitation oil of clove was formulated to contain 60 percent eugenol, 30 percent terpenes and 10 percent eugenol acetate to duplicate the average composition of the natural oil with respect to these components. The absorption of each of these components was important from a flavor

standpoint in that a marked difference in adsorption would give a variation from the true clove flavor.

Unspiced, 4,500 to 6,000 size sweet pickles in a liquor testing 35° Brix, 2.3 percent acid and 2.0 percent salt were spiced in duplicate with a 1:1000 and 1:2000 dilution of natural and imitation spice oils. The pickles were allowed to stand for 30 days after which the amount of spice oils absorbed by the pickles from the respective solutions was determined. The results showed that imitation clove oils was absorbed equally as well as the natural clove oil in both the high and low dilutions. Experiments were also run on pickles from the same lot and under the same conditions with each of the components of the imitation clove oil. The results showed that there was very little difference in the amount of each of the components absorbed by the pickles. All were absorbed in approximately the same proportion.

Preservation of Red Mango Pepper Hulls

FABIAN, F. W. AND HONTZ, L. H.

The Fruit Products Journal and American Food Manufacture, 24 (7): 198-199. 1945. [*Journal Article 744 (n.s.) from the Michigan Agricultural Experiment Station*]

Every year many thousands of bushels of sweet pepper hulls are preserved for use in making relish and for garnishing condiments. The losses due to spoilage are very high, owing to improper methods of preserving. Three methods of preserving them were tried. *Method No. 1* consisted of covering the pepper hulls with 40° salometer brine, (10.6 percent salt) and then adding an additional 9 pounds of salt per 100 pounds of pepper hulls to maintain this concentration of salt. Every week thereafter the salometer test was raised 2° salometer per week until the brine test reached 60° salometer and the brine strength maintained at 60° salometer. *Method No. 2* consisted of covering the pepper hulls with 70° salometer brine and adding 15 pounds of salt per 100 pounds of peppers and maintaining the 70° salometer brine strength throughout. *Method No. 3* consisted of covering the peppers with 50-grain vinegar after which salt was added at the rate of 15 pounds per 100 pounds of pepper hulls. After they had remained in this acid-salt solution for nine weeks, they were washed and covered with 40-grain vinegar. Two varieties, Early California Wonder and World Beater, were used in about equal proportions for the experiments. The former is a thick-fleshed variety while the latter is a thin-fleshed variety.

The results showed that of the three methods tried, Method No. 2 gave the best results. With this method there was practically no fermentation, and most of the yeasts and bacteria had disappeared at the end of the first week. The surface of the brine remained free of scum

and the pepper hulls were firm in texture, had an excellent color and developed few soft areas. The thick-skinned Early California Wonder variety preserved much better than the thin-skinned World Beater. When mature and partially mature hulls were salted together, the mature hulls had less spoilage than the partially mature pepper hulls.

Salting Beets, Carrots, Corn, Green Beans and Spinach

FABIAN, F. W. AND WADSWORTH, C. K.

The Fruit Products Journal and American Food Manufacture, 24: 231-237. 1945. [*Journal Article 745 (n. s.) from the Michigan Agricultural Experiment Station*]

Owing to a shortage of certain critical materials, such as tin in the canning industry, it is conservatively estimated that approximately 80 million pounds of vegetables were salted in 1944. Experiments were conducted to determine the best method of salting vegetables so as to insure maximum keeping and eating quality. Previous experiments on salting sweet and Alaskan peas, green beans, corn, okra, and green lima beans had shown certain methods preferable to others. In this series of experiments beets, carrots, corn, green beans and spinach were salted according to procedures which gave the best results in former work.

The results were as follows: For corn the treatment which caused the least change in the physical characteristics such as color, consistency and flavor after it has been salted, freshened and cooked was salting the blanched corn in 18-percent salt. This treatment yielded a tender corn of good color which had a flavor hardly distinguishable from canned corn. The green beans which had the best color, consistency and had a flavor simulating that of canned green beans after they were canned were those that were blanched and then brined in 18-percent salt. The best treatment for carrots considered from every angle was to wash, dice and blanch them after which they were salted in a brine containing 18-percent salt and 0.3-percent acetic acid after final equilibrium had been reached. This procedure gave carrots which compared very favorably with carrots from the same lot which had been canned at the beginning of the experiment. The color, consistency and the flavor of blanched spinach preserved in 18-percent salt with or without the addition of acetic acid compared very favorably when cooked with that of spinach from the same lot canned when fresh. In the case of beets the best method was to wash and salt whole beets with or without blanching in 18-percent salt. An edible beet comparing favorably in color and taste with canned beets resulted.

These experiments showed that the best flavor in salted vegetables was obtained from blanched vegetables since salting does not inactivate enzymes such as catalase and peroxidase which cause deterioration in flavor. Loss of ascorbic acid is considerable but there is much less loss of carotene during salting.

Apparatus for Growing Microorganisms on a Flowing Medium

LEWIS, R. W. AND LUCAS, E. H.

Science, 101: 364. 1945. [*Journal Article 746 (n.s.) from the Michigan Agricultural Experiment Station*]

The paper describes an apparatus used for growing microorganisms on cellulose tubing. The tubing was employed in order to increase the surface-volume ratio and also to make a pathway through the growing fungus for the medium to pass into and out of the growing culture.

Penicillium notatum grew readily on the tubing after inoculation of the surface by means of a specially constructed atomizer. On the sixth to eighth day after inoculation, depending upon conditions, penicillin could be detected in the run-off medium. The penicillin titre increased within a few days so that it equaled or surpassed that of a flask culture. However, the experiment could not be carried past the sixteenth day because leaks developed in the cellulose tubing owing to the action of the fungus.

Bacillus brevis was grown in this apparatus for three weeks without any apparent breakdown of the cellulose tubing.

The authors believe the apparatus as described can become a useful laboratory tool for studying certain organisms and that, if a better tubing can be secured, it may be adaptable to the production of antibiotics and toxins.

The Colostrum Pregnancy Test in Cattle

CAIRY, CLYDE F.

Jour. Vet. Res., 6 (21): 252-256. 1945. [*Journal Article 751 (n.s.) from the Michigan Agricultural Experiment Station*]

Using a technique similar to that recommended in 1940 by Falls, Freda, and Cohen for use in the human as an intradermal pregnancy test, 322 injections of bovine "colostrum" were made into 35 cows and 17 injections were made into 2 freemartins. The term, "colostrum" as used here applies to the material which accumulates in the udder before parturition in first-calf heifers and not to the postpartum or true colostrum.

Several samples of colostrum were used in various amounts and different dilutions. Analysis from the standpoints of the response of individual cows, the antigen used, the amount injected, and the dilution used indicated that while there appeared to be marked differences in the responses of some animals to certain antigens, the test is not of sufficient accuracy in the bovine to be used as a pregnancy test. It seemed that the variations in responses to the test were due, not so much to the differences between antigens, dilutions, and the amounts injected, as to differences between the individual cows. In other words, whereas no one antigen, dilution, or amount injected gave a high percentage of correct tests, certain individual cows responded with an accuracy of better than 90 percent.

Tests Pertaining to Apples and Pears

BATEN, W. D.

Food Research, 11 (1): 84-94. 1946. [*Journal Article 752 (n.s.) from the Michigan Agricultural Experiment Station*]

Various varieties of apples and pears at 33° and 72° F. were served to adults who were requested to score their decisions concerning desirability and juiciness. A large majority of the judges preferred the fruits at the lower temperature. Cold apples and pears were considered to be juicier than those at room temperature. Tests were carried out at different times of the day to determine which time of the day was the most appropriate for judging these fruits. One set of tests was carried out for every hour of the day from 8 to 5 o'clock. These showed that one time of the day was as desirable as any other time of the day. Very little inconsistency was found among the judges which included more than 200 persons. The majority of the tasters preferred score sheets on which their judgments were recorded numerically. Fruit of inferior quality at refrigerator temperature was considered as desirable as those of superior quality at room temperature.

The Differential Diagnosis of Bovine Brucellosis from the Bacterial Action of Blood Plasma

HUDDLESON, I. F., WOOD, E. AND CRESSMAN, A.

Science, 101 (2623): 358-359. 1945. [*Journal Article 753 (n.s.) from the Michigan Agricultural Experiment Station*]

By making use of the *in vitro* bactericidal action of bovine plasma for *Brucella* abortus, it may be possible to distinguish infected animals from those not infected when both show low serum agglutination titers.

A Study of Diphtheroids Found in Infectious Bovine Pyelonephritis

FEENSTRA, E. S., THORP, F. AND CLARK, C. F.

Jour. Bact., 50: 497-504. 1945. [*Journal Article 765 (n. s.) from the Michigan Agricultural Experiment Station*]

Some of the morphological, staining, cultural, biological, fermentation, and agglutination properties of 19 diphtheroids from cases of infectious bovine pyelonephritis have been determined. The tabulated data were studied in an effort to classify these organisms, especially regarding their relationship to *Corynebacterium renale* which has been described as the etiological agent of infectious bovine pyelonephritis. Thirteen of the organisms were indistinguishable from *C. renale* as described by Bergey. The properties of the other six organisms would not seem to allow them to be classified with any of the corynebacteria now described.

The salient differences were that these six cultures required a richer medium for growth, had more curved pairs in stained preparations, digested litmus milk more vigorously, and produced acid in xylose as well as in fructose and glucose.

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